Our Insect Enemies

THEODORE WOOD

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BY

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PREFACE.

IN the following pages I have attempted to trace the life-histories of some of the more prominent of those insects which are prejudicial to our interests, pointing out in each case the particular manner in which they are injurious, and, as far as possible, the range and extent of their ravages. In so doing, I have avoided all unnecessary technicalities, in the hope of rendering the work of interest to the general reader, rather than to the comparatively few whose avocations compel them to regard the subject as one of personal and special importance.

With a single exception, I have treated the insects described in accordance, not with the particular crops which they frequent, but with their present system of classification, in order to dispense with the vast amount of repetition which would otherwise be necessary. Many species, of course, feed indiscriminately upon a variety of cultivated plants, and would thus require frequent mention, were the arrangement of the work to be based upon the food-plants,

instead of upon the natural order of the insects themselves.

The *Aphis*, however, in its various forms, seems to merit the distinction of separate treatment, for its numbers are so inconceivably great, its powers of multiplication so extraordinary, and its diversity of food so extreme, that it must undoubtedly be ranked as by far the most injurious member of the vast tribe to which it belongs. To this insect, therefore, I have given first place, and have then proceeded to describe its manifold assistants in the work of destruction.

Finally, I have endeavoured to call attention to the invaluable character of the assistance rendered to us by the smaller birds, whose real merit we still fail to appreciate, and which are but too often considered as holding a position diametrically opposite to that which in reality they occupy. The rook, the starling, the titmice, the sparrow, and many others, are the best allies of the farmer, and he who allows them free and undisturbed access to his fields and plantations will seldom need to complain of any great losses caused by insect agency.

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CHAPTER I.

INTRODUCTORY.

BOTH for good and for evil, it cannot be denied that the class of animals known as INSECTS exercises a very important influence upon the well-being of the human race. The appearance of a single species in unusual numbers may be the cause of widespread famine and desolation, rendering abortive all man's attempts to cultivate the crops upon which he so largely depends for a livelihood. The abundance of a second may have a precisely contrary effect, and ensure a rich and even profuse harvest, provided only that the atmospheric conditions be tolerably favourable. Upon the presence or absence of a third, again, may depend the possibility of rearing and keeping cattle; while a fourth, although not robbing us of any of the necessaries of life, may yet deprive us of many of its luxuries. It is, therefore, a matter of no little consequence that we should carefully investigate the life-histories of these beings, individually so insignificant, but collectively so im-

portant, in order that we may discover the particular manner in which the influence of each is exerted upon ourselves and our interests, and, more particularly, that we may efficiently check its ravages if an enemy, or encourage its increase if a friend.

This task is not a light one. The habits of many species are so obscure, and the earlier stages of their existence are spent under conditions so impossible to reproduce in confinement, that the endeavour to gain even a general idea of their economy would seem a hopeless undertaking. But, after all, such insects are, comparatively speaking, the exception, and not the rule. A very large proportion may be placed under observation during the earlier stages of their existence without any very great difficulty, and, even with those which do not come into this category, much may be done by means of outdoor investigation. Were the truth to be known, indeed, it may be doubted whether there is one insect in a hundred with whose habits we might not in some measure render ourselves acquainted.

Much, no doubt, has already been done in this direction. The life-histories of thousands of insects have been worked out by careful observers, who have given us tolerably complete information upon many points of interest and utility. But more, far more, has still to be performed. We have as yet proceeded but a short distance upon the long journey which lies before us. We have learned certain facts, and, in some few cases, the application of these facts with regard to ourselves. But, with the great majority of

insects, we are totally ignorant of all that it is most necessary to know. Except by analogy, we cannot tell that they pass through any introductory stages of existence at all. We do not know upon what they feed. We do not know whether they are beneficial or injurious with regard to our own interests. We cannot pretend to the least acquaintance with the causes which bring about their abundance or their scarcity, or which allow of their existence in certain districts, and not in others to all appearance equally suitable. Nor have we learned what precautions should be taken to keep down their numbers, should they prove noxious, or to encourage their increase should their influence be beneficial.

Again, it may reasonably be doubted whether there exists a single insect which is not in some way serviceable to us, or which might not become so were we sufficiently familiar with the details of its life-history to perceive the particular manner in which it might be of benefit. The Silk-worm, for instance, from a foe has become a friend, for we have found that, although our mulberry-trees may suffer from its attacks, it yet furnishes us with an article of commerce of the highest utility, thereby far more than compensating us for any losses caused by the character of its food. How many of the human race depend for their subsistence upon the silk trade in its various branches! And if with one insect, why not with others? The Lac insect supplies us with sealing-wax and varnish, and the Cochineal insect with a valuable dye; and both these, it must be remembered, are

closely related to the destructive Scale insects, or *Cocci*, of our own country. The Spanish-fly, or Blister-beetle, again, furnishes us with a most useful medicinal substance, the recognition of the utility of these insects having been comparatively recent. May such instances not be the pioneers of many yet to come, and an encouragement to us to proceed further in the vast field of entomological research?

BE this as it may, there are a vast number of insects which, in the present state of our knowledge, we cannot consider in any other light than in that of foes. Not, of course, in the sense of foes provided as such by the hand of Nature; for the greater proportion are inimical to man simply on account of his civilisation. As long as he remained in the condition of a savage, neither cultivating crops, storing up grain, nor making in any sense a provision for his future, so long did these beings occupy towards him a perfectly neutral position. But, when he found that by tilling the ground, and by rearing and tending cattle, he could ensure for himself an ample supply of food at all seasons of the year, he altered the natural conditions, and brought a multitude of previously neutral insects into direct enmity with himself. And almost every succeeding year adds, and will add, to the list, for each discovery which transfers a hitherto neglected plant to the kitchen-garden or the pharmacopæia, or which places a formerly unappreciated animal under domestication, increases the number of our insect foes by those which feed upon the plant in question,

or which are parasitic upon the animal taken into our service.

But, though we can scarcely expect to decrease the list of these in the future, we may reasonably hope so to add to our knowledge as to discover the most effective methods of reducing their abundance, and, possibly, to apply even the most destructive to some useful purpose, which may go far to compensate us for the damage which they bring about by the nature of their food. Had we but possessed such knowledge in the past, what losses might not have been averted! Could our predecessors, for instance, have realised the fact that the small birds were their most important auxiliaries in the task of destroying the various insect pests, and so have encouraged instead of persecuting them, we should now be obliged to rely far less upon our own exertions in order to secure even a moderately abundant harvest. By the thoughtless and wholesale slaughter of their untiring foes, a great impetus was given to the increase of almost all the insects injurious to man, and from this increase we are not only now suffering, but must still suffer in the time to come.

And, even at the present day, it is astonishing to find in how many cases the old prejudices still prevail, in spite of the vast and widespread increase in scientific knowledge. In too many farmyards do we see row upon row of owls, kestrels, sparrows, and finches nailed upon the walls, victims to the guns and traps which are even yet considered as indispensable adjuncts to agriculture, while the mole-killer displays his victims

by scores in the very pastures which so largely owe their verdure to the misunderstood little animals. And, more suicidal still, we even hear of hop-growers employing a large staff of men to kill the ladybirds found upon the bines, thus encouraging, by the most effective means in their power, the destructive aphides, or "green blight," upon which those ladybirds were feeding.

I quote the following remarks from a short paper, upon injurious insects, from the pen of Mr. S. L. Mosley, of Huddersfield:—

"Not many years ago the ladybird was most abundant; it absolutely swarmed upon almost every kind of vegetation. During that summer I *saw* more than one gardener picking off the ladybirds and stamping them under his feet, and I heard of one 'corporate body of gentlemen' ordering out the fire-engine, with tobacco-fumigated water, in order to assail the harmless little insects."

But those whose avocations bring them into the closest contact with Nature are, as an almost invariable rule, the most hopelessly ignorant of her secrets, and seem to pass through life with their eyes closed, blind to all which they do not consider as specially connected with their own business. Show to an average farm-labourer, who has spent almost his whole life in the open air, a common blindworm, and he will tell you that it is a poisonous snake; a toad, and he will say that it spits fire; a newt, and he will affirm that its sole object in life is to kill cows; a lizard, and he will inform you, probably with a scream of terror, that it

bites the haymakers and reapers as they are lying asleep in the sun, and causes them to swell until they burst. And, only a year or two ago, a gardener forwarded to the British Museum a common Two-spot Ladybird, under the impression that he had captured a veritable specimen of the dreaded Colorado Beetle.

The man knew no better. He had very likely seen, in the ordinary course of his business, some fifty or sixty ladybirds daily, but they had left no impression upon his mind. He saw them, as men see daisies by the roadside, paying no heed to them, and scarcely knowing that they were there. Then, when his attention was directed to the fact that a certain destructive insect was likely to make its appearance in the country, and he found a beetle actually crawling upon a garden plant, he leaped at once to the conclusion that this must be the dreaded visitor itself, his intellect being incapable of containing two ideas upon a subject outside his daily routine.

And so with nine out of ten of those engaged in agriculture. They are content to accept blindly the various prejudices of their class, without caring to ascertain for themselves whether those prejudices have any certain foundation in fact. And, once having accepted them, they decline to listen to any arguments which might prove to them that they are mistaken.

The real value of the insectivorous birds and their assistants can scarcely be over-estimated. The Starling, for example, performs work which it is hardly possible for us even to attempt ourselves, extracting

the terrible wire-worms, and the almost equally destructive grubs of the Daddy-long-legs, from their fancied security beneath the soil, and killing them literally by hundreds of thousands. The Rook is almost equally valuable, although its services are marred by the depredations which it commits in our corn-fields. Even the much-abused Tits and Finches themselves, which so frequently incur the ire of the agriculturist, destroy, for every sound bud which they devour, at least a dozen which were tenanted by some destructive grub.

The Mole, again, whose hunger is literally insatiable, is constantly driving his tunnels through the soil in order to secure the various grubs which conceal themselves among the roots of the crops, and which cause damage of far more consequence, although not immediately apparent, than any wrought upon the leaves or the fruit by their companions in mischief. Toads and Frogs are most valuable assistants in the work of destruction, while many predacious and parasitic insects, such as the Ladybirds and the Ichneumon-flies, are of inestimable service, their abundance atoning for their individual insignificance.

The late Mr. E. Newman has treated this subject with so much simple force in his "Natural History of British Moths," that I make no apology for transferring his remarks to these pages. Speaking of the Turnip-moth, he says:—"All my own observations tend to show that Nature is her own physician, and that neither allopaths nor homœopaths can do anything better or wiser than allow Nature to work out her own

cure. In our own bodies we find that almost every disease can be traced, more or less directly, to some interference with the course of Nature: we eat too much, or drink too much, or interfere in some way with Nature's laws; inconvenience follows, and we demand a second interference to balance the first. It is exactly thus with the world of animals. Birds, insects, all living things have their appointed food: this is a law with which it is dangerous to interfere: the present instance is as good an illustration of this as can possibly be given. Nature supplies roots as the food for the turnip-grub. Man increases the supply of food prodigiously; Nature increases the number of devourers prodigiously. The farmer does everything in his power, and very properly so, to increase the crop of swedes, turnips, mangold-wurzel, potatoes, and so forth; Nature does all in her power to increase the number of the grubs so abundantly supplied with food; these grubs are the especial and favourite food of certain birds—the partridge, the rook, the starling. Following up the invariable law, Nature multiplies the birds because of this superabundant supply of grubs; man thwarts Nature, destroys the birds, and gives immunity to the grubs. Thus we allow the grubs to increase—in fact, give them every encouragement; they revel in the abundance we have provided for them, and we wonder at their voracity, and demand a remedy for the injury we have caused. This principle of interference is carried on by man in very many other instances in a manner highly detrimental to his own interest: he pays the

price of a sack of grain for every owl nailed to his barn-door, because that owl would destroy mice every night; and these mice, being relieved of their oppressive enemy, would, in a very short time, consume a sack of wheat, peas, or beans. The kestrel, in like manner, kills mice, and the death of a kestrel may fairly be reckoned a loss of five pounds. A sparrow-hawk left to himself, even by scaring the sparrows from the ripening grain, will save the wages of at least three boys. In Scotland, the incessant warfare against birds of prey, and the near accomplishment of their extermination, has allowed such an increase of the ring-dove as to threaten, owing to its insatiable voracity, a dearth of cereals for the food of man. Associations are formed, officers appointed, speeches made, rewards offered: the object being solely and exclusively to remedy the evil which the speechmakers have, by their supposed sagacity, induced. Fifty such instances might be given, but let us take the particular instance of the turnip-grub. Two birds make it their special and favourite food: these are the partridge and the rook. . . . . Neither of these birds is favoured with a place in that 'gamekeeper's museum,' the bole of an oak or the door of a barn: but, nevertheless, they are persecuted for sport or destroyed by poison, and, whatever the pretext for the slaughter, the effect is the same."

In the task of keeping down the numbers of the various insects which are injurious to our interests, therefore, we shall not go very far astray if we rely chiefly upon the exertions of those beings which have

been appointed as their natural enemies. No animal, from the greatest to the least, is without certain foes, to whom power has been given to check its increase, and so to prevent it from appearing in undue abundance. And the relations of these to one another have been so accurately adjusted that the numbers of each remain practically unaltered year after year, any occasional superabundance of the one being counteracted by the increased numbers of the other.

In encouraging these foes, therefore, we shall be far better employed than by experimenting with various chemicals, in the vain attempt to do for ourselves work which can be far more effectively performed by the beings specially appointed for the task. Not, of course, that we should not supplement their labours by our own,—far from it. Occasions annually occur upon which nothing but immediate measures of extirpation will save some crop from total destruction by certain noxious insects. But we ought to recognise the fact that we shall best consult our own interests by trusting as far as possible to Nature, assisting her if practicable, but depending upon her efforts more than upon our own.

And, if we need further proof, none more convincing can we have than the almost invariable rule, that no insect is found in greatly increased abundance in two consecutive seasons, although one would naturally suppose that, the impulse once given, its numbers would either increase in a ratio proportionate to the number of eggs deposited by the particular species, or, under less favourable conditions, would at least

remain stationary. In certain years some insects will be present in myriads, causes with which we are not acquainted having influenced their development and rate of increase. But, although these may deposit their eggs, and although the young grubs may make their appearance in due course of time, hardly one tithe will arrive at maturity, for their many enemies will perform their work so efficiently as to render the species in the following season conspicuous by its very scarcity. The vast swarms of cabbage-butterflies which appeared in this country in 1842, of the aphides which devastated our hop-grounds in 1869, and of the Painted Lady butterfly and the Silver Y moth which visited us ten years later, found no counterpart in the following seasons, the insects in every case being remarkably scarce, and doing little or no damage. Nor are these isolated instances only, for were we to study the records of the last fifty or sixty years, we should find that such has been the universal rule, and that in every case the diminution in the numbers of the pest has been almost wholly due to the unceasing persecutions of its natural enemies.

As regards the precautions which we ourselves should take with a view to reducing, or altogether preventing, the attacks of the various insects which ravage our crops, there is one point to which we should particularly direct our attention. And this is, that the principal necessity is so to strengthen the plants during the earlier stages of their growth, that they may quickly attain such size and maturity as will

enable them successfully to resist attacks which would prove fatal to them in a less forward degree of development. It is of greater service to our peas and beans, for instance, that they should be thoroughly manured and tended while yet young, than that hours of labour should be expended upon them, when more advanced, in freeing them from the insects which are sure to visit them. A strong and healthy plant can outgrow damage which would enfeeble or even destroy one less robust, just as a strong man can pass almost unharmed through an attack of disease which would be fatal to one of weaker constitution. Such a plant can thus, in a certain measure, bid defiance to its foes, while one not so carefully tended withers and dies beneath their attacks. Those means, therefore, which will accelerate the growth of the crops during the period in which they are most liable to damage, should always be preferred to methods of prevention which do not come into operation until after the attack has taken place.

Then, again, we should take all possible advantage of the assistance at times afforded us by the elements. Heavy rain, for example, will wash various destructive insects from the crops in hundreds of thousands, to perish, in the majority of instances, before they can regain their food-plants. But this only if they are unable to find harbourage in which to shelter themselves until a change takes place in the weather. If weeds, sticks, refuse matter, &c., are allowed to remain in the fields, we deliberately deprive ourselves of the assistance so freely rendered, for a large pro-

portion of the dislodged insects will take refuge therein, and remain perfectly unharmed until they are able to recommence their depredations.

Certain applications, of course, are necessary, especially when the insects make their appearance in unusual abundance, and must be immediately dealt with in order to save the crops from total destruction. But, unfortunately, very few of those which are often recommended are of the slightest service; their very number and variety testify to their own worthlessness. Referring to a recent account of the well-known American Blight, for instance, I find a list of no less than twenty washes of different kinds which are stated to be more or less effectual. Were but one of these of any true value, we should never again hear of the remaining nineteen; and so also in many other cases of similar character.

It is my intention, however, in the following pages, not so much to discuss these, as to give a short description of the life-history of some of our more noxious insects, tracing the development of each, whenever possible, from the egg to the perfect state, and showing the particular manner in which its ravages are carried on. The bulk of the work will be devoted to those species which are injurious to our agricultural interests, by feeding upon our different crops, either before or after they are gathered in, and which are consequently of far greater importance than others, such as the flea, which are only personally troublesome. As our space is limited, too, none will be considered but those which are either indigenous

to Great Britain, or which, although originally importations, have by long residence become naturalised, as these are necessarily of greater interest and importance to ourselves than others which have no immediate influence upon us, or which, although prejudicial to our interests, are yet beyond the reach of any efforts which we can make to check their ravages.

There are many insects, however, which, even in our own country, are more or less injurious, but which, owing to their very number, cannot even be separately mentioned. I shall, therefore, select those which are more especially mischievous, and whose life-histories have been worked out with tolerable completeness, in preference to others with which we are less acquainted; giving, as before stated, the fullest possible account of their habits and doings, from the moment in which they appear in the world as eggs to that in which, the task of their life accomplished, they die in order to make way for the succeeding generation.

Were we fully acquainted with these details in the history of all the noxious insects, the task of reducing their abundance and checking their depredations would be far more easy than is now the case, and we should seldom or never have to complain of losses which might have been avoided had our knowledge been more complete. Now that attention is so generally being called to the subject, we may well, however, hope for greater success in the future, when the obscurity in which the life-history of many species is

still veiled shall have been cleared away, and we shall have learned, not only the full extent of the difficulties with which we have to cope, but also the most successful means of combating them. Year by year we may reasonably trust that the losses caused to us by insect agency shall be diminished, and that although, perhaps, they may never be altogether prevented, they may yet be reduced to a minimum so small as to be scarcely worthy of consideration. This happy consummation, however, can never be brought about excepting by hard and earnest work, and by the co-operation of all those who are interested in the matter—and these two necessaries, let us hope, will not long be wanting.

CHAPTER II.

THE APHIS, OR "GREEN BLIGHT."

The Aphis and its destructive character—Number of species—Its fastidious taste—Individual insignificance of the aphis—Its extraordinary powers of multiplication—Professor Huxley's calculations—Foes of the aphis—Their inestimable value—Thoroughness with which their work is performed.

PERHAPS, of all the beings which we are accustomed to rank together under the title of Injurious Insects, there is none, save the locust itself, whose destructive powers are greater than those of the Aphides, Plant-lice, or Green Blight, as they are indifferently termed, and none capable of causing more terrible and wide-spread damage to the crops upon which man so largely depends for a livelihood. There is scarcely a plant or a tree, whether wild or cultivated, which escapes their ravages,—stem, leaves, fruit, and even the very roots themselves, being alike attacked and drained of their life-juices by the insatiable little creatures, whose numbers compensate for their individual weakness, and render them one of the direst pests to which civilised man is subject.

The word Aphis, of course, in the sense in which we now employ it, is a generic, or, more strictly speaking, a family term, for, even in this country

alone, we have at least one hundred and eighty species of these destructive little insects, and it is more than probable that many others will ultimately be discovered. As a general rule, each of these is attached to some particular food-plant, which alone fulfils its fastidious requirements, and which generally suffers greatly from the incessant attacks of its unwelcome guests. This rule, however, does not always hold good, for in some few cases the same species is found upon plants widely different from one another. The Hop Aphis, for example, feeds upon the sloe in the earlier part of the year, while that infesting broom is also found upon the common mint. It seems, however, to be invariably the case that any individual aphis, having once fed upon the juices of a particular plant, will suffer voluntary starvation rather than submit to any change in its diet, even though the new food-plant may be tenanted by numbers of its own species, and may be closely allied to that upon which it was originally found.

By one totally ignorant of entomology, the aphis is probably the very last insect which would be selected as an injurious being, its small size and feeble structure seeming to afford abundant evidence that its capabilities for mischief must be exceedingly limited. But Nature has in many instances delegated tasks of the most stupendous magnitude to the smallest and weakest of her creatures. Much of the soil beneath our feet is composed of the shells of animalculæ so minute as to be totally invisible except under a high

power of the compound microscope. Large tracts of land are raised from the depths of ocean by the mis-named coral "insects;" while the purification of the earth from decaying and noxious matter, and the preparation of the soil for the growth of vegetation, are entrusted to beings seemingly quite unfit to perform tasks of such importance. And, as with them, so with the aphis, which, notwithstanding the delicacy of its structure and the feebleness of its limbs, yet exercises a most powerful influence upon the growth of the various crops without which the existence of mankind upon the earth would be but a very doubtful possibility.

It may seem a wildly exaggerated and unjustifiable statement if we say that, but for certain opposing agencies, the aphis would over-run the entire world; that it would leave scarcely a green leaf upon the earth; and would cause such terrible devastation that all terrestrial life would wholly disappear, and the globe become one vast desert, incapable of supporting animation, and utterly without living beings of any kind. Still more impossible would it appear if we were to state that this ruin and desolation would be the outcome, not of many centuries of gradual increase, but of only a few short months.

Incredible as the assertion may seem, however, such results are no more than must logically follow if the aphis could be allowed to remain perfectly unmolested during a period of but a single year. For the economy of the insect is so extraordinary, and its multiplication so infinitely rapid, that, wonder

as we may, the fact remains the same that, but for the influence of atmospheric changes, and also, in at least equal measure, for the unceasing attacks of its natural enemies, the aphis would in that short space of time become the master of the world.

In order fully to understand how this can be, it is first of all necessary to look into the life-history of the aphis, and to compare it with that of insects in general. For it cannot be denied that in many respects the aphis stands alone. No other being could increase in numbers with such marvellous rapidity, and none, however superior in size and strength, could bring about such wide-spread havoc in so short a period of time. By the side of the aphis, the lion, the tiger, the wolf, and the elephant, all so destructive when forced into contact with man, fade into positive insignificance, for, were the hindrances to the increase of any of these totally withdrawn, the result could not be one tithe as appalling as that which would inevitably ensue were the foes of the aphis to relax their efforts even for a few short months.

But for their wonderfully rapid rate of increase, of course, the aphides would be comparatively harmless, for they are all of such small dimensions that individually they can do but little damage. But their powers of multiplication are so enormously great, and their development is completed in so short a space of time, that a large colony may often be found in localities where a week previously scarcely a specimen could have been discovered; and this even if no immigration has taken place from other districts.

The secret of this marvellous rate of reproduction lies in the fact that the aphis is almost totally exempt from the law which provides that insects shall pass through three introductory stages of existence—viz., the egg, the grub, and the pupa,—before passing into the perfect condition. It is true that eggs are laid by the insect at certain times, notably at the end of the year, when provision is made for the first generation of the forthcoming season. It is also true that these eggs will produce grubs, which will in due course pass into the pupal state before attaining to their mature form. But this is the exception and not the rule, for the females which are produced from these eggs will bring forth, not eggs in their turn, as one would naturally suppose, but living young, which at once begin to feed, and which, after one or two changes of skin, are as perfect in every respect as their parents.

Now, however, comes a most extraordinary point, and one which is almost unique in entomology, for these in their turn also produce living young, which, until the last brood of the season, are invariably females; and generation after generation thus appears in rapid succession, not only without passing through the usual introductory stages of development, but, more singular still, without the presence of the male insect. Impossible as it may appear, this fact has nevertheless been proved by careful examination of the insect in confinement. Having taken precautions to effectually prevent the admission of the male aphis to the cage, investigators have found that this singular

mode of reproduction may be continued as far as the twentieth generation, thus showing that, as a general rule, a single parent is sufficient for the requirements of these extraordinary little creatures.

Now we see the cause of the wonderfully rapid rate of multiplication, for, as each insect begins to give birth to young very shortly after its own entry into the world, and as each lives under ordinary circumstances for from four to five weeks, several generations will in a short time be simultaneously produced, and the original parents will find their children, grandchildren, great-grandchildren, and great-great-grandchildren making their appearance in ever-increasing numbers. It is thus evident that, before very long, the insects must accumulate by a sort of geometrical progression, and, if unchecked in any way, must in the course of a few months fill every inch of space upon the face of the globe.

This is no overdrawn picture, for the calculations which have been made by those who have carefully studied the subject enable us to form some slight and imperfect conception of the vast myriads to which the progeny of a single female would amount, were the various agencies which keep them in check to be withdrawn even for a short period of time. Réaumur, for instance, estimated that one aphis may be the progenitor of no less than 5,904,900,000 individuals during the few weeks over which her life extends. Carrying on the computation, another authority found that at the end of three hundred days the living produce of the original aphis, exclusive of those whose

existence had run its natural course, would amount to no less than the fifteenth power of 210, or, in figures, 68,122,318,582,951,682,301,000,000,000,000,000,—a number totally beyond our powers of realisation.

Seeing the utter impossibility that such a row of numerals should convey any definite impression to the mind, Professor Huxley made a curious calculation, intended to bring home to us the true significance of the figures by which the rate of increase of these insects is indicated.

He assumes, first, that one thousand aphides weigh collectively no more than one grain avoirdupois (which is certainly below, rather than above, the mark); and, secondly, that only a very stout man can weigh as much as two million grains, or rather above twenty stones. Then he tells us that the tenth brood alone of the descendants of a single aphis, supposing that the multiplication had been altogether unchecked by the various causes which generally influence it so greatly, would be equivalent in point of actual matter to more than five hundred millions of stout men, or one-third of the entire population of the globe, supposing that each individual member were of sufficient corpulence to turn the scale at two hundred and eighty pounds.

If we carry on the calculation, however, to the three-hundredth day, or, in other words, to the fifteenth generation, the result is still more wonderful, for we find that the living descendants of the one aphis would be equal in weight to 34,061,159,291,475,841,150,500,000 stout men, or

more than twenty-two thousand seven hundred billion times the population of the entire globe. To use the words of a living writer, "there would be room in the world for nothing else but aphides!"

Even these figures, inconceivable as they are in their magnitude, are yet very far below the actual truth, for all the foregoing computations have been based upon the assumption that each aphis is capable of producing twenty young, and twenty young only, during her entire existence, whereas more than that number are frequently born in the course of a single day. Could we arrive at the exact truth, indeed, we should find ourselves confronted by a number almost too great to express in figures, and of such infinite vastness that by no possible means could our minds be brought to realise it.

Now, it must be recollected that these myriads of living beings would be the produce of but a single aphis, whose multiplication had been permitted to remain unchecked by the incessant attacks of the various beings which have been deputed by Nature to keep its numbers within due limits. Now let us suppose that the hostility of these creatures could be withdrawn for a time from all the aphides at present existing upon the earth, and estimate, if possible, the dire results which would inevitably follow.

In the first place, every living aphis would give birth to young, which would immediately begin to increase with alarming rapidity, and, only kept down in part by atmospheric influences, would speedily overspread the entire habitable world. To satisfy

their voracious appetite the whole of existent vegetation would prove insufficient. The earth would be stripped of almost every green leaf, and plants, shrubs, and trees, with very few exceptions, would be totally destroyed. All graminivorous and herbivorous animals, deprived of their food, would shortly die of starvation. The predacious species, after preying for a time upon one another, would eventually disappear, the aphides themselves, having exhausted the food-supply, would also die, and the world would thus be stripped of all living beings, with the exception of those which find a home in the water. Many of these, even, would be destroyed, depending, as they do, so largely for food upon the decaying animal and vegetable matter which finds its way into our ponds and streams, and which, of course, they would before long be unable to obtain.

The fact that no such terrible increase ever takes place is a wonderful testimony to the efficiency with which Nature's appointed agents in the work of destruction perform their allotted task. Atmospheric changes, of course, exercise a very considerable influence upon the numbers of the insects, for heavy rain will wash them by thousands from the plants upon which they are feeding, and so damage them as to render them incapable of regaining their lost position. But no one who has ever noticed the vast diminution in the numbers of the aphis, which invariably follows closely upon the appearance of ladybirds or hawk-flies in unusual plenty, can doubt for a single moment that parasitic and predacious

foes may be relied upon with far greater certainty as a means of reducing the abundance of the pest than the possibly unsuitable condition of the weather. For there is this great difference between the two agencies, that, whereas the latter may very likely be favourable to the development of the destructive little insects, the former never can be so.

In certain seasons, however, the aphis seems for a time to set its various foes at defiance, and appears in such myriads as to cause an infinity of damage to the crops in the districts which it happens to infest. The hop is especially liable to its ravages, the advent of the "fly," as it is termed by the growers, being looked for with fear and trembling, much as the appearance of the locust is anticipated in Eastern countries. Wheat, too, is attacked by a species of aphis, and is often greatly injured by its ceaseless persecutions, while there is scarcely a plant or a tree which is entirely unmolested. All gardeners are acquainted with the masses of "blight" which are almost invariably to be found upon their rose-bushes, or clustering upon various fruit-trees in such abundance as to render the branches unsightly to the eye and disagreeable to the touch, causing the leaves to wither and the fruit to be stunted or even altogether absent. And for every specimen that is seen, ten at least pass without notice.

But in all such cases of excessive abundance, the different foes of the aphis rise to the occasion, and perform their work so thoroughly that in the following season the numbers of the pest are once more restricted

within the ordinary limits. This is also the case with other injurious species, the same causes seeming to operate, although indirectly, upon the development both of the destroyer and of its different enemies, so that the plague of the one is shortly counteracted by the increased numbers of the other. We have had many instances of this fact, but none, perhaps, more striking than that afforded us in the year 1842, when a vast flight of cabbage-butterflies appeared upon our coasts and deposited their eggs. The larvæ resulting from these, however, were almost wholly destroyed by the exertions of a small species of ichnuemon-fly, which performed its task so well that scarcely one caterpillar in fifty attained to the perfect state.

It may, possibly, be that in ordinary seasons a large proportion of the parasites are unable to meet with victims, and so die without depositing their eggs, while, during such visitations as the above, all are equally able to carry on the work of destruction. If this be the case, as seems very probable, the increased abundance of ladybirds, &c., during years when the aphis is present in unusual numbers, and of other predacious and parasitic species upon similar occasions, would be fully accounted for.

CHAPTER III.

THE APHIS, OR "GREEN BLIGHT" (*continued*).

Structure of the aphis—Characteristics of Order to which it belongs—The beak, or proboscis—Analogy with mouth-parts of other insects—Different portions of which it is composed—Variation in individual species—The limbs and their office—The cornicles, or nectaries—"Honey-dew" and its character—Its injurious effects upon vegetation—Suppositions as to its origin—Mr. Buckton's observations—Reputed medicinal virtues of honey-dew—Aphides as "ant-cows"—Care with which they are treated by ants—Eyes of the aphis—Their treble form—Absence in root-feeding species—Structure of wings—Iridescence—Connexion of upper and lower pairs during flight.

BEFORE proceeding to discuss the habits of the aphides, it will be necessary for us to devote a short space to the consideration of their structure, in order that we may thoroughly understand, not only their life-history, but also their influence upon ourselves and the manner in which that influence is exerted. And, as the general formation is tolerably similar in all the species, we will take one as a type of the remainder, selecting for our purpose that found upon the common rose (*Siphonophora rosæ*), as being more or less familiar to us all.

In the first place, of course, the insect must possess the special characteristics of the particular order to

which it belongs, viz., that of the *Homoptera*, or "same-winged" insects. The upper and lower wings, therefore, when those organs are present, are of similar structure,—both pairs being wholly membranous,—and do not overlap one another when their owner is at rest. The body is more or less convex, the mouth is set on the lower surface of the head, and the place of the jaws is occupied by a sharply-pointed beak, or proboscis. The pupa, too, is active instead of quiescent, and is remarkably like the perfect insect in appearance.

In the next place, the feet are never formed of more than two joints, this being the distinguishing feature of the particular division in which the aphides are comprised. Then the body is soft, full, and even bloated in appearance, the limbs are feeble, and, as a general rule, two small tubes, known as "nectaries," or "cornicles," are situated upon the upper surface of the abdomen. Lastly, the shape of the body is almost invariably either oval or spherical, a linear form being only possessed by a few exceptional species.

So much for general characters. It is now necessary to enter somewhat more into details.

To begin with the beak.

This is a very important part of the structure, its peculiar formation alone allowing the aphis to carry on its destructive work. In many insects a beak or proboscis is substituted for jaws. The butterflies and moths, for instance, are furnished with a long and flexible trunk, which can be coiled away beneath the head when not in use, and through which the

juices of flowers can be drawn into the mouth. The gnat and the flea are provided with weapons capable of piercing the skin, in order that the blood of the victim may be extracted. In the bees the same organ is half tongue and half proboscis, by means of which honey is swept from the flowers to which the insects resort. All these different forms, however, are merely modifications of the parts of the mouth known as the mandibles, the maxillæ, or lesser jaws, and the labium, or lower lip, which are developed in the manner most suitable for the requirements of the particular species.

And the same is the case with the aphis. If we take the beak of this insect, place it beneath a tolerably high power of the microscope, and carefully examine its structure, we find that it is composed of several portions, to each of which a definite purpose is assigned, but which are nevertheless so exceedingly delicate that the entire weapon is barely visible to the naked eye. There is, first of all, the sheath, which serves as a protection for the whole, and which is deeply channelled upon its upper surface. This sheath itself is compound, consisting of no less than three joints, of which the first is much longer than the remaining pair, while the second is perforated instead of furrowed, in order to give greater support to the boring weapons. These are three in number, and are sharply pointed after the manner of a surgeon's lancet, being, moreover, so constructed that they can be worked freely backwards and forwards, in order to make a puncture sufficiently large to

allow the sap to be sucked into the mouth. The edges of these boring tools are not serrated, however, as might be supposed, the keenness of the points being quite sufficient to enable them to perform their task.

This must be taken as the structure of the typical aphis-beak, some little variation being found in certain species.

In leaf-feeders, for instance, it is usually short, as, the sap lying near to the surface, it is not necessary that the wounds which it causes should be of any great depth. In those species which penetrate the bark, however, it is naturally of much greater length, and, curiously enough, is usually longer in the larva than in the perfect insect. To so great an extent is this sometimes the case, indeed, that the beak, when not in use and packed away beneath the body, actually projects beyond the end of the abdomen, causing the insect to appear as though possessed of a long and delicate tail. And, in one most singular aphis, known as *Chermes laricis*, which is found upon the common larch, the piercing organs of the beak are not only of great length, but are also spirally coiled, so that, when introduced into the bark, they act as a kind of anchor, and prevent their owner from being either blown or washed from its foothold by the strong winds and heavy rains so prevalent in early spring.

The limbs also vary very much in point of length, being in some cases long and delicate, and in others so short as to be scarcely visible. In no case do they appear to be gifted with any great muscular

strength, power of limb not being needed by the aphis, which seldom requires to shift its position, and never, except in periods of general migration, wanders far from the spot upon which it was deposited by its parent. Even upon these exceptional occasions the legs are not required, for the task of locomotion, of course, is performed entirely by the wings.

The nectaries, or cornicles, as they are indifferently termed, next claim our attention, and are especially interesting, as being peculiar to this group of insects.

These are small tubular organs, which are situated upon the upper surface of the sixth segment of the abdomen, and vary to some extent, both in form and size, in different species. In some cases they are half as long as the entire body; in others they are so short as to be scarcely visible. Sometimes they take the form of mere perforated tubercles; sometimes they are altogether wanting. In each individual species, however, when present, they are remarkably constant both in shape and colour, and are thus exceedingly useful as characters of distinction between allied forms.

There is, perhaps, no development of insect anatomy which has given rise to so many suppositions with regard to its office as have these cornicles, upon whose functions naturalists even yet are not universally agreed. Many authorities have considered that they perform the part of auxiliary spiracles, or orifices by which the air is admitted into the respiratory system, and have brought forward very plausible arguments in support of their theory; others have supposed them to be directly connected with the

digestive apparatus, and to act as excretory organs. It seems tolerably certain, however, that their true duty lies in the distilment of the curious liquid which is popularly known as "honey-dew," on account of its sweet taste and glutinous consistency. This honey-dew is produced in quantities proportionate to the abundance of the food-supply, a drop of the fluid gradually forming at the extremities of the cornicles, and falling off after a time to give place to a successor.

Here we may trace a curious parallel between the aphides and those insects popularly known as Frog-hoppers, or Cuckoo-spit, which also belong to the order of the *Homoptera*. Both feed upon the juices of plants, and the sap in each case passes so rapidly through the system that its ejection is almost continuous, the one insect allowing it to fall in drops to the ground, and the other surrounding its own body with a frothy mass of liquid. Well is it for us that none of our British species are so energetic as one found in the island of Madagascar, which absorbs the sap with such extraordinary rapidity that a continuous stream of liquid passes from its body while it is engaged in feeding, the juices appearing to run through its system much as water runs through a sieve.

Were it not for the distilment of the honey-dew, the attacks of the aphis would be far less harmful; for the plants, although they would still suffer injury from the loss of their sap, might still in many cases outgrow the damage to which they had been subjected. But the thick and glutinous fluid ejected by

the insects, which is not unlike thin treacle in point of consistency, so chokes the pores of the leaves, which perform much the same office as do the lungs of animals, as to cut off all communication with the air, and thus adds a second and almost equally severe injury to that already inflicted. It is not at all uncommon to find the leaves of such trees as the plum, the sycamore, and the lime as completely coated with honey-dew as if they had been steeped in the liquid, and showing by their drooping and withered appearance how severe has been the result upon them.

Some naturalists, still doubtful as to the origin of this fluid, have attempted to prove that it is not necessarily caused by aphis agency, as the leaves of certain trees are often to be found covered with honey-dew when the blight is apparently altogether absent. But, as Mr. Buckton has pointed out in his well-known monograph, the aphides feeding on trees of great elevation confine themselves almost entirely to the lower surfaces of the leaves, and thus, after repletion, would sprinkle the upper surfaces of those beneath them with the fluid ejected from their cornicles. And, even if this be not the case in any particular instance, the presence of the secretion may well be explained by the fact that on hot summer days the winged forms often hover over the trees, and void their juices while on the wing.

The same author also records an observation of his own, which seems to supply us with a conclusive proof that the honey-dew is not, as has often been supposed, a vegetable product. The note is as follows:—

"Weycombe, Haslemere, Aug. 23, 1874.—Bright, sunny morning. The under sides of the oak-trees well tenanted by winged and apterous females of *Callipterus quercûs*. The upper surfaces of the leaves of the Portugal laurels, growing under the oaks, are freely sprinkled with shining spots of honey-dew. On gently touching one of the *winged* females, the abdomen was raised, and a bright particle, easily seen in the sunshine, was projected from the summit of one of the short cornicles. The garden seats on the open lawn are also sprinkled with the same spots. This last fact can scarcely be reconciled with the idea that honey-dew is of vegetable origin."

It is a rather curious fact that, so surely as an insect produces any peculiar secretion, that secretion is supposed by some section of mankind to possess certain medicinal virtues. Of this strange rule we have an admirable instance in the common ladybird, the oily liquid exuded by which is, or was, a popular remedy for the toothache. And so also with the honey-dew proceeding from the cornicles of the aphis, which seems in some parts of the world to take high rank amongst healing applications. The Italian peasants, for instance, employ it in the treatment of wounds. In certain parts of France, too, it is considered as a specific for sore eyes; while the residue, after the fluid elements have been evaporated, is supposed to be a palliative in diseases of the chest.

Be its uses to man what they may, it is undoubtedly held in great esteem by certain other insects, chief among these being the ants, which treat the aphides

in so singular a manner as to have earned for them the popular title of "ant-cows." There must be few who have ever watched the aphides upon a summer's day, and yet have not noticed the almost invariable presence of ants among them, which treat them with the greatest care, and protect them, if need be, from danger. Sometimes an ant may be seen to grasp an aphis with its fore-legs and administer a gentle squeeze. Taking the hint, the aphis, unless it has shortly before done so, exudes from one of the cornicles a small drop of the honey-dew, which is immediately licked off by the ant. A second specimen is then laid under contribution, and so on, until the appetite of the ant is appeased.

Not content with visiting the aphides when desiring the sweet substance, the ants generally transfer a number of the insects to their own nests, in order that a supply may be always available. Even during the winter the prisoners are kept in captivity. Only a few days before writing these lines I found, in a colony of the Yellow Ant which I was investigating, quite a little cluster of aphides clinging to the roots of some weeds round which the nest had been built, and guarded by half a dozen ants, which were acting as gaolers. No sooner were the unwelcome daylight and the cold air admitted than a very busy scene began, one detachment of the ants setting to work to repair damages, and another to carry off the captives into the interior of the nest. Although the temperature was but a degree or two above freezing-point, both aphides and ants were perfectly active,

the thin crust of earth which I had removed seeming to have been quite sufficient to protect them from the influence of the cold.

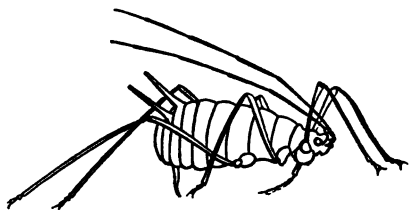
There are still two parts of the structure of an aphis which must not be passed by without mention, and these are the eyes and the wings.

The former of these are noticeable for one or two very curious points. Insects in general, as is well-known, possess eyes in two distinct forms, viz., *ocelli*, or single eyes, generally very few in number, and compound eyes, formed of a number of separate lenses. But aphides, adding yet another to their many peculiarities of structure, are in many cases furnished with eyes of *three* distinct forms, namely, ocelli, compound eyes, and supplementary eye-tubercles. These latter, which are two in number, are situated upon the corner of each of the compound eyes, and are furnished with from five to ten facets, which do not seem to differ in any way from those of the compound eyes themselves. In both cases, however, the lenses are hemispherical, instead of hexagonal, as is generally the case.

What the office of the supplementary eyes may be, we are quite unable to determine. There seems no reason why an aphis should be more highly gifted with the sense of sight than are other insects, more especially as it is not predacious, and seldom moves from place to place excepting at seasons of general migration. That they must serve some purpose is evident from the fact of their presence, but the nature of that purpose is one of the many mysteries with

which we still find ourselves surrounded when we attempt to peer into the secrets of Nature.

As though to render the object of their presence still more mysterious, it is only in certain species that these eyes are found. Some aphides, indeed, are without eyes altogether, being root-feeders, and therefore not requiring the sense of sight; while others possess the ocelli and the compound eyes alone. These latter are generally furnished with three ocelli

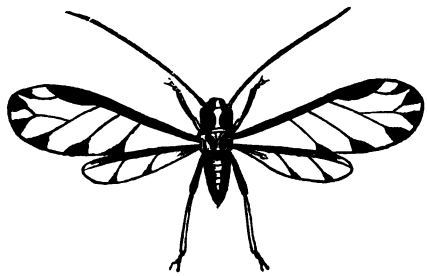


Aphis tiliæ
(Wingless female).

only, one or two favoured species, however, possessing as many as six.

The wings, when present, are of great beauty, more especially when viewed through a microscope. The membrane of which they are composed is marvellously iridescent, every imaginable colour playing over it in turn, and altering and changing with every movement of the insect; while the network of nervures which supplies the organs with the necessary rigidity is exceedingly graceful in design, varying considerably in different species, but always alike elegant and beautiful.

The lower wings are invariably smaller than the upper pair, and are connected with them during flight by means of a small hook placed upon their upper, or costal, margin, and fitting into a fold in the posterior margin of the upper pair. The four wings are thus during flight practically reduced to two, just as is the



Aphis tiliæ
(Male).

case with those of the butterflies and moths, and also of the bees, wasps, ichneumon-flies, &c.

Having now briefly described the principal points in the structure, we will proceed to the life-history of the aphides, selecting as before the species found upon the common rose to serve as a type of the remainder.

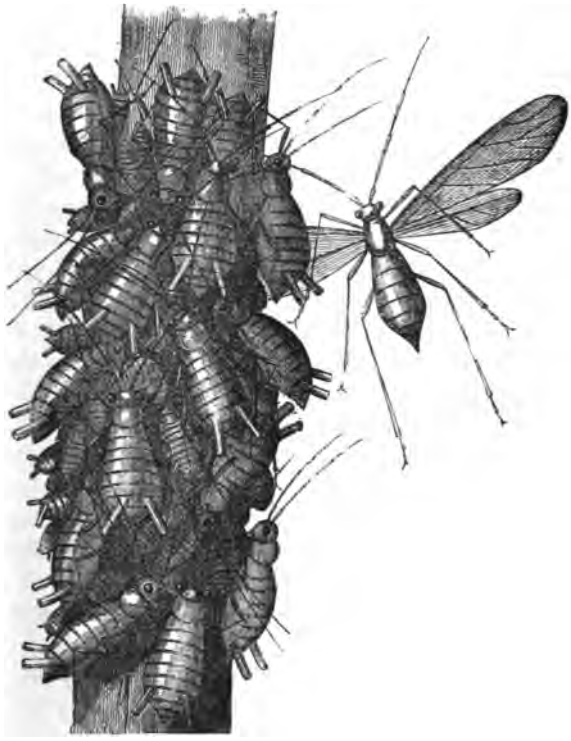
CHAPTER IV.

THE APHIS, OR "GREEN BLIGHT" (*continued*).

Different forms of aphides—Winged and apterous varieties—Why the wings appear—Emergence of an aphis from pupal skin—Cold winds and their effect upon aphides—The sexes of the aphis—The oviparous and viviparous females—Temperature and its influence upon development—Vitality of female insects—The eggs of the aphis—Their variation in different species—Change of tint—Number of the eggs—How they are laid—Larvæ of aphis—How distinguished from perfect insects—Their changes of skin—The pupal form—Weakness of flight of aphides—Consequent tendency to migration—A singular species of aphis—Dimorphism—The *Phylloxera* and its two forms—Possible influence of dimorphism upon extirpation of aphides.

If we take a sprig from a rose-bush which is infested with aphides, and carefully examine its occupants with the aid of a magnifying-glass, we shall probably find that several apparently distinct forms are to be noticed among them. Some are green, others red; some are large, others small; some are furnished with wings, others destitute of them; and so on. Yet all these, different though they may be in appearance, nevertheless belong to one and the same species, the distinctions between them being chiefly due to the various degrees of growth and maturity at which they have arrived.

Not altogether so, however. The perfect insect, for instance, may be either winged or apterous, ac-



Cluster of Aphides.

cording to circumstances, as is the case with many members of the order to which the aphis belongs. In several of these instances the winged form is of

excessive rarity, the naturalist perhaps meeting with but two or three examples in the course of a life-time, although apterous specimens are everywhere abundant. In other cases, the winged and the wingless forms are almost equally plentiful, as is the case with the insects now under consideration.

With the aphides, however, the perfection of form implied by the possession of the power of flight is attributable, by one of the many contradictions which we find in the life-histories of these singular beings, not to a superficiency or a superfluity of food, but to the want of it. A badly-nourished aphis actually produces offspring of greater structural perfection than one whose food-supply has never failed in point of either quantity or quality. And this evidently for the following reason. While food is plentiful, the organs of locomotion are unnecessary. The aphis, like insects in general, lives but to eat and to propagate its kind, and is perfectly satisfied with its quarters so long as its provender shows no signs of running short. But when, either from its own incessant attacks or from other causes, the leaves begin to droop and the sap to fail, the insect is obliged either to seek fresh pastures or to die of starvation.

As soon as this is the case, therefore, a slight difference may be noticed in the form of the newly-born aphides, a small hump or projection being visible upon the thorax. This hump contains the nucleus of the future wings, which attain their full development as soon as their owner passes into the perfect state, and supply it with the power of changing at

will its old habitation for a new. Whenever winged aphides are seen in any abundance, therefore, it is a sure sign that the plants infested by them have been reduced to so unhealthy a condition as no longer to fulfil the requirements of the insects.

The winged aphis emerges from the pupal skin very much as does a butterfly from the chrysalis, a rent opening in the skin behind the eyes and rapidly spreading to the thorax. Through this rent the head of the enclosed insect shortly appears, the body and limbs follow, and before very long the operation is completed, the empty skin still standing entire, and looking, but for its transparency, almost exactly as it did before the emergence took place. These pupal skins may often be seen in hundreds on rose-bushes, looking, as Mr. Buckton remarks, "like the ghosts of their former selves."

The wings themselves, at the moment of emergence, are soft and pulpy, and are perfectly useless for purposes of flight. The membrane of which they are composed, however, gains strength very rapidly, the organs quickly expand to their full size, and in a wonderfully short time the process of development is complete and the insect ready to take to the air.

It may seem curious if, as many naturalists hold, the sudden appearance of aphis swarms in early spring is a result of the cold winds which are so prevalent at that season of the year. But it is by no means unlikely that this may really be the case, for the consequent check to the flow of sap doubtless so impoverishes the food of the insects, that they seek by

migration to improve their condition, just as is the case when food fails them owing to other causes.

Towards the end of autumn a brood of aphides occurs consisting of both sexes, the males usually preceding the females by a few days. The latter of these are oviparous, the eggs deposited by them passing uninjured through the cold months of winter, and giving birth to larvæ early in the following spring. It is worthy of notice that the oviparous females of many species of aphis possess broad and flattened hinder limbs, sometimes even set with small tubercles, in order to assist them in the task of affixing their eggs to the food-plant of the future young.

Many observers have stated that one and the same aphis produces upon some occasions eggs and upon others living young. This, however, is not the case. The egg-laying female is never viviparous, for she is obliged to take measures that shall secure the protection of her offspring from the wintry cold, and this she could not do were they to make their appearance in the world as living beings. In the egg state alone can they survive, not only the frosts of winter, but also the long deprivation of food to which they must necessarily be subject, and in the egg state only are they consequently produced by the oviparous female.

It must not be thought, however, that the foregoing remarks apply to all aphides alike, for certain species, such as that found upon the larch (*Chermes laricis*) are exclusively oviparous, and the members of the last brood produced in the season pass through the winter in a state of hibernation, awaking from their

torpor and resuming their interrupted feast early in the months of spring. As a general rule, however, the eggs are laid at the end of autumn only, the parents dying when winter sets in, and their offspring not making their appearance until the cold season is at an end.

The appearance of the oviparous females depends in a great measure upon the state of the temperature, being accelerated by cold and retarded by warm weather, so that the destructive work of the insect is carried on to the last available moment. In captivity their appearance has been delayed for a space of no less than four years, by keeping the cage which contained the insects artificially warmed. During the whole of that period each succeeding generation was composed of viviparous females only, the ordinary atmospheric influence having been neutralised. It would seem, however, that the effect of a low temperature alone is not always sufficient to bring about the appearance of the egg-laying form, for the viviparous female has been known not only to live through severe frosts in early winter, but also to carry on her ordinary operations for weeks afterwards.

However this may be, it is tolerably certain that the duration of the life of an aphis is largely dependent upon the state of the thermometer, for, if cold weather should check its fertility, it will live for a much longer period than under ordinary circumstances. This, of course, is merely an exemplification of the universal law that an insect's existence, unless violently cut short, shall be prolonged far beyond its

normal limits if the great task of its life be not accomplished, in order that it may make the necessary provision for a succeeding generation. And it is especially astonishing to find what injuries the female will survive, provided that her eggs have not been deposited. I have at different times met with cases in which such insects have been crushed almost flat, have lost their heads through some accident, or have been drenched with chloroform,—and yet have lived for days afterwards, and succeeded in laying their eggs. Before the young are brought into the world, the vitality of the parent is so great as to enable her to survive the effects of injuries which to creatures more highly organised would be immediately fatal. On the other hand, the accomplishment of the maternal duties seems in almost all cases to utterly exhaust the bodily strength, and it is a rule, with but very few exceptions, that the female insect dies almost immediately after her last egg is deposited.

THE eggs belonging to different species of aphides vary very much in size and number, and also in the manner in which they are laid. Those of the common rose aphis, for instance, are nearly half the length of the entire body of the parent, and are fastened to the food-plant by means of a thick and glutinous fluid, with which they are lubricated as they pass from the ovipositor. In common with those of many other species, these eggs are of a pale yellowish-green tint when first laid, but change by degrees to a deep black hue, just as a horse-chestnut

alters from white to brown after enduring a few hours' exposure to the air and light. We find, also, that the same phenomenon takes place in a variety of other cases. An insect when freshly emerged from the pupal shell, for example, seldom exhibits any trace of the hues which it will possess when fully mature, and may not altogether gain them until after the lapse of two or three days. A very familiar instance of this fact we may find with regard to the common cockroach, the insect being almost white when it throws off its pupal covering, and only assuming its mature tint by very slow degrees; and so also with other insects. The dark-loving beetles, in particular, are very slow to assume their true colouring, and, in the case of a prettily-marked scarlet and black species, which I took when fresh from the pupal shell, I have known as many as five days to pass before the red spots attained their full brilliancy, although the insect was placed in a glass-covered box, and exposed to the direct action of the sunlight.

In consequence of the large size of the eggs of the rose aphis, they are deposited singly, the insect being unable to carry more than four or five in a developed condition. As each is expelled, however, its place is taken by the germ of a successor, so that a comparatively large number are laid by each female before her life comes to an end. By carefully examining the twigs of rose-bushes during the winter these eggs may often be found, looking not unlike tiny grains of gunpowder.

Some aphides place but few eggs upon a single

twig, contenting themselves with small clusters of four or five only. Other species, however, deposit their eggs in large batches of several hundreds, and protect them, in some cases, by means of the down torn from their own bodies, just as is done by the Gold-tail and the Brown-tail moths among the *Lepidoptera*. The larch-feeding *Chermes laricis*, which has before been mentioned, is one of these, and, moreover, places each egg separately upon a short footstalk of cement, somewhat after the fashion of the common Lace-wing fly.

The larvæ, when newly emerged from the eggs, are very similar to the perfect insect in general form, and are not very far inferior in point of size. The antennæ, however, are not so long as those of the adult specimens, and generally consist of fewer joints, while the legs are always very small and stout. The nectaries, too, in those species which possess them, are very small, and are sometimes so slightly developed as barely to be visible. Before attaining to the perfect condition several changes of skin take place, the insect showing after each some slight advance in its progression towards the adult form.

It is a somewhat singular fact that aphides which enter the world as living beings are more highly developed than those which proceed from eggs, the antennæ, the legs, and the nectaries being alike of greater length, and the number of joints in the former being often largely increased. The members of the second brood of the year, therefore, are practically more perfect than those of the first.

The pupal form appears only when the necessity for migration brings about the presence of the winged insect, the future organs of flight being first visible in the shape of a small swelling upon the thorax. Signs of the ocelli, too, may generally be seen in certain minute spots, which appear on the vertex of the head and at the margin of the compound eyes.

Although the wings are of large size in comparison with the bulk of the aphis, the insect, on account of the extreme lightness of its body, is by no means active when in the air, and is, indeed, almost wholly at the mercy of the wind. Hence the large swarms of aphides which occur at seasons of general migration, the members of which are obliged to travel in company owing to the force of the breeze, which they are quite unable to withstand. Herein lies the great difference between the migration of aphides and that of birds, the latter travelling to a certain spot whatever the atmospheric conditions, while the former merely rise into the air, and allow the wind to blow them whither it will.

All winged aphides appear to consider that flight is far too important a business to be entered upon without careful preparation; and even the mere act of rising is not accomplished without some little difficulty, the insect first accurately arranging its wings in the proper position, and then ascending with manifold rotations of body, and by very slow degrees. One species, *Chermes laricis*, which seems to burn with the desire of singling itself out from its relatives by every means in its power, goes through a most

absurd pantomime before commencing its ascent, first throwing itself upon its back, and then whirling rapidly round and round for several moments, just as does a water-beetle if placed upside down upon a plate or other polished surface.

BEFORE concluding our remarks upon the life-history of the aphides, a few words are necessary concerning the curious subject of Dimorphism, or the two more or less diverse forms assumed at different seasons of the year by one and the same species. We have already had an instance of this peculiarity in the case of the common rose aphis, the members of the second and following broods of which differ in many respects from those of the first. But the variations in this case are of a very minor character, when compared with those exhibited by certain other species. In *Chermes laricis*, as a matter of course, and also in an aphis found upon the apple, the first and last generations are quite unlike all the intermediate broods, and we have a still more striking instance in a sycamore-feeding species, which assumes in early spring forms so widely distinct from one another that they have been separately described as belonging; not only to different genera, but also to different families. The terrible aphis known as the *Phylloxera*, too, which has caused such great and widespread damage in the vineyards upon the Continent, is dimorphous to a wonderful extent,—one form, which is possessed of wings, being found upon the leaves and shoots of the vines, while a second,

which is apterous and sluggish, lives a subterranean life upon the roots, which it so damages that the plant shortly withers and dies.

This is one great reason why the *Phylloxera* is so terribly destructive, for, as it appears in two distinct forms, with habits so entirely different, it is almost impossible to dislodge it when once it has made its appearance, the subterranean specimens more especially being protected by the very nature of their abode from the ordinary agents employed in the task of insect destruction.

It is very likely that this singular fact of dimorphism may, when it is more thoroughly understood, clear up for us many of the mysteries now surrounding the life-histories of certain aphides. There are many species, for example, with whose doings we are acquainted during a part only of the year. We find them busily engaged in feeding, perhaps, for a period of six or eight weeks, and then suddenly discover that they have vanished, to appear no more until the following season. We cannot trace them during the intervening time. We do not know whither they go, or in what stage of development they pass through the winter. All we have ascertained is, that they disappear from our ken for the greater part of the year, and we have hitherto altogether failed to discover in what manner and for what reason they do so.

But, if these species are dimorphous, the difficulty is at an end. Any of these aphides, after appearing in one form for a month or two, may then migrate,

and show itself in a totally distinct shape upon a different food-plant, remaining thereon until the frosts of winter oblige it either to hibernate, or to deposit its eggs and die. For all we know to the contrary, the error made in the double description of the sycamore aphis may have been repeated in a multitude of other instances, and a number of our so-called species be in reality nothing more than varying forms of others, examples of the dimorphism which has been already proved to exist in many cases, and which may very probably also occur in as many more. And that this question should be cleared up is a matter of no little importance, for it may very well be that the numbers of an aphis appearing in different forms might be more easily kept down under the conditions surrounding the one than under those encompassing the others of these, and a little active exertion undertaken at one season of the year, perhaps while the insect is not actively injurious, might thus be far more efficient than the most thoroughly organised system of destruction at another.

CHAPTER V.

THE APHIS, OR "GREEN BLIGHT" (*continued*).

Individual species of aphis—*Siphonophora granaria*, and it abundance—Its destructive character—Manner in which its attacks are made—Parasitic flies and their value—Possible dimorphism of *Siphonophora*—The hop aphis—Its irregular appearances—Havoc caused by its attacks—Influence of hop aphis upon Treasury receipts—Impossibility of checking its ravages—*Aphis mali* and its depredations on the apple—Dimorphism again—Curious method of attack—*Aphis pruni*—*Pemphigus lactucarius*, or lettuce aphis—Its subterranean abode—Difficulty of exterminating the Pemphigus—"American Blight" and its destructive habits—Its wool-covered body—"Rusticus" on "Blight"—Method in which damage is inflicted—Summary.

HAVING now briefly glanced at the structure and the life-history of aphides in general, we will devote a short space to the consideration of the individual species which are injurious to our interests, by feeding upon the crops which we raise for our own use, and damaging them so greatly as to prevent them from arriving at maturity. And the chief of these is undoubtedly that found feeding upon wheat, rye, oats, and other cereals, our corn crops being naturally of principal importance among those upon which we are dependent for so large a proportion of our food supply.

This insect, which we may call the Corn Aphis,

and which is scientifically known as *Siphonophora granaria*, is found upon many wild grasses, and is sometimes exceedingly abundant in our corn-fields in early summer, first attacking the young blades near the stem, but afterwards transferring its attentions to the ears, and inserting its beak at the points at which the grains spring from the stalk. While the crops are still soft and green, the damage which the insects cause is often incalculable, for they not only withdraw the sap from the plant and choke up its pores with the honey-dew which proceeds from the nectaries, but also cause great and incessant irritation by the numberless punctures made by their tiny beaks. Later on, when the corn begins to change colour, and to assume the flinty hardness which characterises both ears and stems as they approach maturity, it can bid defiance to its foes, which are no longer able to insert their beaks as before, and so must necessarily discontinue the drain upon its juices which was rapidly robbing it of life.

This being the case, therefore, it naturally follows that a late crop of wheat is much more liable to injury by aphis agency than one which ripens comparatively early in the year, as it affords the insects more extended opportunities for carrying on their mischievous operations, and is, moreover, first attacked by them at an earlier stage of its growth. So, as a general rule, the aphis is most destructive in a backward season, and is often present in such overwhelming numbers that scarcely a single grain of corn can be found which has not a specimen upon it, busily

engaged in extracting the juices upon which the life of the plant depends. In some aggravated instances, as many as two hundred aphides have been counted upon a single ear of wheat. Before very long the results of the continual drain upon the sap begin to make themselves manifest. The beautiful tint which is so characteristic of the ears and stems in the early period of their development rapidly disappears, and gives place to a sickly yellowish hue; the plants assume a faded and withered appearance, and, if relief be not at hand, are speedily reduced to so debilitated a condition as to be beyond all hope of recovery.

Were it not for the constant exertions of certain parasitic flies it is, indeed, doubtful whether, even in ordinary seasons, we should be able to bring our corn crops to maturity, for the aphides increase in number so rapidly, and our own means of dealing with them are so very inadequate, that our chances of checking their ravages would be exceedingly small were we entirely unassisted in the task. But these tiny flies are ever upon the watch for victims, and the hosts of dead aphides which may be found towards the end of summer, each with an orifice in the skin through which the parasite has emerged, bear ample testimony to the efficient manner in which their work is carried out. Mr. Curtis, in his valuable work on "Farm Insects," has called attention to this subject in the following words:—"The wheat-ears in the above year (1842) afforded a beautiful illustration of the economy of parasitic insects, and the benefits

resulting from their agency. On some wheat which we examined not a single aphis had escaped the searching vigilance of its enemies, and the husks were spotted with immovable black shining globules. On a closer examination, it was evident that these were aphides which had been punctured by minute parasitic flies, and that, as they increased in bulk, the little internal maggots thrived upon their fat until the aphides died from exhaustion, their bodies being gummed by a natural secretion to the chaff and stalks, their antennæ and legs remaining just as they were during life, and likewise retaining their natural colours. I placed these infested ears in a box; and after a short time I bred from them two distinct species of parasitic flies."

In spite of the abundance of the corn aphis, no observer has as yet been able to ascertain either the manner in which it passes the winter, or the time when the eggs are laid. It may possibly be one of the dimorphous species, and, by appearing after the wheat is harvested in a form distinct from that in which it was previously found, have led us to consider it as a different insect altogether, as was the case with the aphis which feeds upon the sycamore.

Perhaps there is none of our British aphides which has attracted so much notice as that which infests our hop-grounds, although, as the hop-plant is in no sense a necessary of life, its ravages are really less important than those of its corn-feeding relative. But the insect frequently appears in numbers so vast, and causes such terrible havoc among the bines, that

it is scarcely a matter for wonder if it receives greater attention than the more injurious but less prominent species.

In average seasons, this aphis, scientifically known as *Phorodon humuli*, makes its appearance in our hop-grounds towards the middle of May, its advent being looked for with great anxiety by the growers. The numbers of the visitors, however, and the rate of their increase, are very variable and uncertain. Sometimes, in the space of only a few weeks, the insects will multiply so rapidly that hardly a single sprig will be free from the pest; in other cases scarcely a specimen will be seen throughout the year. Much of this variation is, no doubt, due to atmospheric conditions, a dry and sultry summer being generally, but not invariably, favourable to the development of the insects, and a cold and wet one prejudicial. But it is probable that some cause, beyond that of the weather alone, exerts a powerful influence upon the multiplication of the insects, although its particular character has hitherto eluded our powers of observation.

It is tolerably certain, however, that if the hop-bines be sickly from any cause before the visitation of the aphides takes place, the insects will rapidly increase in numbers, the unhealthy sap appearing to have greater charms for them than that drawn from bines which are free from disease. In such cases the crop is almost irretrievably doomed, and in many seasons the loss resulting from the havoc wrought by the "fly" has amounted to many hundreds of

thousands of pounds. Some idea of the magnitude of these losses may be gained by a perusal of the following extract from the "Letters of Rusticus":—

"In the year 1802, on May 14, the duty was laid at £100,000; the fly, however, appearing pretty plentifully towards the end of the month, it sank to £80,000; the fly increased, and by the end of June the duty had gone down to £60,000; by the end of July to £30,000; by the end of August to £22,000; and by the end of December to £14,000; the duty actually paid this year was £15,463. 10s. 5d. In 1825, the duty commenced at £130,000, but, owing to the excessive increase of the fly, had in July fallen to £16,000; at the beginning of September it rose to £29,000, but towards the end fell again to £22,000; the amount paid was £24,317. 0s. 11d. In the following year the summer was remarkably dry and hot; we could hardly sleep of nights with the sheets on; the thermometer for several nights continued above 70° all the night through: the crop of hops was immense, scarcely a fly was to be found, and the betted[1] duty, which began in May at £120,000, rose to £265,000; the gross duty actually paid was £468,401. 16s. 1d., being the largest amount ever known. From this it will appear that, in duty alone, a little insignificant fly has control over £450,000 annual income to the British Treasury; and, supposing the hop-grounds of England capable of paying this duty annually, which they

[1] *I.e.*, estimated.

certainly are, it is very manifest that, in 1825, these creatures were the means of robbing the Treasury of £426,000. This seems a large sum, but it is not one-twentieth part of the sums gained and lost by dealers during the two years in question."

And such losses are the more mortifying in that no human exertions will suffice to check the ravages of the insects when they have once gained the upper hand. We are obliged to stand helplessly looking on, while our crops are destroyed before our eyes. A large staff of men may be employed to wash the plants, and to administer all the approved remedies, with the very best results when the aphides are not particularly numerous. But in their seasons of abundance no such proceedings are of any avail. The more determined the attacks that are made upon them, the more they seem to flourish, and none but their natural enemies, the ladybirds, the lacewing and hawk-flies, and the parasitic ichneumons, can successfully cope with their myriads. It is evident, therefore, that our best plan, when the aphis hosts appear, is to encourage, by every means in our power, these the appointed agents of Nature in the work of destruction, and to make our own personal endeavours a very secondary consideration.

ANOTHER very destructive aphis is that inhabiting the apple (*Aphis mali*), which sometimes occurs in such numbers that large orchards are wholly prevented from bearing fruit. This is one of the dimorphous species, the apterous members of the

first brood of the year, which proceed from the eggs laid by the last generation of the preceding season, being of a dark greyish hue, mottled with green, while their successors are very variable in colour, some specimens being green, others yellow, and still others red. The wingless, egg-laying female is of a dull brownish green, with a reddish mark upon the head and thorax, and is by no means a striking insect in appearance. The winged viviparous female, however, is much more handsomely coloured, the head, antennæ, and thorax being black, the abdomen green, and the legs yellow, with black knees and feet. A curious fact with regard to this insect is the exceedingly small size of the male, which can boast of barely one-eighth of the dimensions of his spouse.

The mode of attack pursued by the apple aphis is in one respect unlike that followed by the species already described, for the insect, which appears as soon as the buds show signs of bursting, punctures the lower surface of the leaves, which are affected in such a manner by the consequent irritation as to curl backwards from the points towards the stems. Each leaf, therefore, forms a kind of chamber, in which the aphides are protected, not only from the effects of unfavourable weather, but also in a great measure from many of the foes which are ever ready to destroy them.

An apple orchard which is infested to any great extent by the aphis presents a most deplorable appearance, the leaves being shrivelled and withered,

the branches bare of fruit, and the trunks covered and blackened by the secretion of its destroyers. And, if immediate measures of preservation are not taken, the trees must inevitably die, for the weakness caused by the irritation ensuing from the multitudinous punctures, the continual loss of sap, and the stoppage of the pores through which respiration is carried on, is so great that recovery is impossible under ordinary circumstances, the only exceptions being in cases in which either the trees are of exceptional strength or the soil of unusual fertility.

By far the most successful application for infested trees seems to consist of a strong solution of soft soap, which adheres to the insects and speedily destroys them. According to some authorities, too, the sap is affected by the alkali in so peculiar a manner as to prove distasteful and unwholesome to the aphides, and thus to kill such specimens as have escaped the immediate effects of the liquid.

These remarks apply also to the aphis which so greatly damages plum-trees in certain seasons (*Aphis pruni*), and which affects the foliage just as does the species inhabiting the apple, causing the leaves to curl by the irritation resulting from its incessant puncturings, and so providing itself with a retreat in which it is tolerably safe from its enemies. It is rather curious that a variety of the common hop aphis is also found upon plum-trees in company with the above species.

PASSING by the aphides which find their food

respectively in the sap of the cherry, the gooseberry, the currant, the bean, the turnip, and many other cultivated trees and plants, and whose destructive powers are only too well known to the agriculturist, we will devote a few words to that found upon the lettuce, and which is scientifically known as *Pemphigus lactucarius.* This insect differs in several respects from those which we have hitherto discussed, being, for example, a root-feeder, and not possessing the nectaries or cornicles through which the honey-dew is poured forth.

Owing to the locality which this aphis selects in order to carry on its destructive operations, it is a most difficult insect to deal with, for the first intimation of its presence lies in the sudden withering of the plants affected, and the mischief is then generally too far advanced to allow of the crop being saved. And, moreover, applications, whether chemical or otherwise, to destroy the insect are so weakened in passing through the soil, that in many cases the aphis suffers no injury whatever, and continues its ravages perfectly unharmed.

Then, again, being concealed beneath the ground, the root-feeding aphides are secure from the attacks of many of the foes which would otherwise keep their numbers within due limits, but which are unable to follow them into their retreat. It would seem, indeed, that the only chance of bringing an infested crop safely through an attack would be to deluge the plants with manure water, in order to stimulate their growth, and so to render them strong enough to

throw off the ill effects caused by the drain upon their juices. If too withered to be resuscitated by such treatment, every possible means should be taken of destroying the aphides while in the ground, and so preventing them from migrating to another district.

WANT of space forbids even the mention of many aphides which are injurious, and we must perforce conclude our description of these destructive beings with a few remarks upon that curious insect known by the popular title of American Blight (*Schizoneura lanigera*).

No doubt most of my readers have noticed, upon the trunks and branches of many apple-trees in orchards and kitchen-gardens which they have visited, certain mysterious patches of a white, downy substance, not unlike cotton-wool, with which the chinks of the bark are here and there filled up. These patches are a sure sign of the presence of the American blight, whose bodies are thickly clothed with a kind of woolly fibre, and which are fully as mischievous as are those of their relatives which have already been described. A very graphic and amusing account of these insects has been given to us by the author of the celebrated "Letters of Rusticus," whose remarks are so full of interest that I cannot but reproduce them in these pages.

"In very hot weather," says Rusticus, "you may now and then see this blight on the wing; it has just the look of a bit of cotton, or a downy seed,

floating in the air, and is driven by every breath of air quite as readily.

"If you catch and examine it, you will find it to be just like the plant-louse which infests our rose-trees, &c.; but, unlike all other plant-lice, it is clothed and muffled up with cotton-wool in such quantities, that you would at first have no more idea that the lump contained an insect than that the mass of clothes on a stage-coach box in winter contained a man. Some folks wonder what can be the use of so much clothing; I am not much of a theorist, but I should guess that the vermin came from the torrid zone, and Nature kindly furnishes this garment to protect them from the cold of our climate.

"These blights wander wherever the wind pleases to carry them, and if bad luck should drive one of them against the branch of an apple-tree, there it will stick, creep into a crack in the bark, bring forth its young, and found a colony. The white cotton soon appears in large bunches; branch after branch becomes infected; the tree grows cankery, pines, and dies. How this is effected no one knows, though the plague and its doings are too evident to escape the notice of the commonest clown.

"In large orchards it is in vain to hope for a cure, but not so in gardens. Directly you see the least morsel of cotton, make up your mind to a little trouble, and you will get rid of it. In the first place, get a plasterer's whitewashing brush, then get a large pot of double size, make your man heat it until it is quite a liquid, then go with him into the garden and

see that he paints over every patch of white, though not bigger than a sixpence; the next morning have the size-pot heated again, and have another hunt, and keep on doing so every morning for a fortnight. Your man will tell you it's no use; tell him that's your business, not his: your neighbours will laugh at you for your pains; do it before they are up. I have tried it, and know it to be effectual. Spirit of tar has been used with partial effect, so also has resin; whitewashing has been often tried, and, as it contains some size, is not entirely useless, and some horticulturists think it ornamental; I do not."

The manner in which the damage is inflicted, of course, is much the same as in the case of other aphides, viz., by the constant drain upon the sap, and also by the irritation ensuing from the numberless punctures caused by the beaks of the destroyers. The result of this irritation is rather curious, the woody fibres beneath the bark losing their healthy firmness, and becoming soft and swollen. After a time the bark, unable to bear the strain upon it, splits over the swelling, and the wood itself is thus exposed to fresh attack. At the end of summer the swollen growth dries up, and a deep crack is consequently formed, which is surrounded by a greater or less quantity of perfectly dead wood.

In the following season the injury is resumed. The tree, endeavouring to recover itself, surrounds the wounded parts with new wood, which, being soft and full of sap, is at once seized upon by the aphides. These with their insatiable appetites, speedily bring about a

recurrence of last year's calamity, and so the work of destruction goes on, until the tree can no longer repair the ever-increasing ravages made in its substance, and gradually withers away. In many an old apple-orchard scarcely a tree can be found which is not more or less infested with the blight, measures of prevention having been neglected until the insects had multiplied to so great an extent as to render their extirpation a well-nigh impossible matter.

WITH this insect we must conclude our account of the aphides, a group of insects which, taken collectively, probably cause greater losses to mankind than any other of the beings which have proved injurious to our interests. Indeed, if we take one year's record with that of another, even the locust itself can scarcely vie with the aphis, albeit so destructive a creature that it has been selected as the instrument of the Divine vengeance in scourging the human race. It is true that the former, when it appears, leaves the country over which it has passed as bare as though scorched by fire, not a green leaf nor a blade of grass escaping the universal devastation. But, as a general rule, the insect seldom revisits that neighbourhood until after the lapse of several years. Its armies perform their terrible work, and then vanish, to be seen no more, perhaps, until their ravages have been well-nigh forgotten. But not so the aphis. That we have always with us, varying in numbers, it is true, but never altogether absent, and seldom even in abundance sufficiently reduced to render its operations a matter of

indifference to us. And, moreover, if one crop escapes, another may not. Our corn may suffer, be our hops never so free from blight, and so in like manner with our vegetables and our fruits, which seldom or never arrive at maturity without receiving more or less injury from the presence of the aphis.

Once more, in countries inhabited by the locust, vegetation recovers itself after injury far more readily than in our own more temperate climate, and the destruction of a single crop does not, as with us, necessarily imply the loss of an entire year's produce. A second and even a third supply of seed may be sown, and result in harvests which far more than compensate for former deficiencies; so that the appearance of a locust-swarm, although doubtless a great and severe calamity, can scarcely be regarded as equally formidable with that which would ensue were our own land to be over-run with aphides in proportionate abundance. The aphis, indeed, may well be considered as the scourge of the vegetable world, and, until we discover some means of utilising it for our own purposes, must be regarded as the chief of all the insects which are known to be injurious to the interests of man.

CHAPTER VI.

CHAFERS AND WIREWORMS.

Injurious Beetles — The Rose-beetle, or Rose-chafer — Its singular beauty—Life-history of the rose-beetle—Ants and their visitors—Do ants keep pets?—The pupa of the rose-beetle and its cocoon — Time of appearance of perfect beetle — The Cockchafer — Its nocturnal habits — The respiratory system, and its influence upon the flight—Duration of life in the cockchafer—Uncalled-for pity—Life-history—How the eggs are laid—The grubs and their appetites—Their clumsy appearance—Mischief caused by their presence—Insectivorous birds and their uses—The cockchafer as a pupa—Damage wrought by the perfect beetles—Cockchafers upon the Continent—The June-bug, or Summer-chafer — Its dusk-loving habits — How to distinguish it from the cockchafer—The Smaller June-bug, or "Cockerbundy"—Its beauty—Life-history—How to recognise a Lamellicorn beetle — Wireworms and their parents—Skipjacks—Why so called—The "Mucro," and its office—Life-history of the wireworms — Insectivorous birds again — What we owe to the rook — *Agriotes lineatus*, and its mischievous habits—*A. obscurus*—*Athous hæmorrhoidalis* — False wireworms — How to distinguish them from the true—Foes of the wireworm.

In order, as far as possible, to avoid unnecessary repetition, we will from this point consider the different injurious insects in the order of their zoological classification, rather than according to the plants upon which they feed, beginning with the Beetles, as standing at the head of the list.

FIRST in the long catalogue comes the well-known Rose-beetle, or Rose-chafer (*Cetonia aurata*), so odious to gardeners on account of the damage which it causes to their roses and strawberries, and to agriculturists from its habit of devouring the flowers of turnips left for the purpose of obtaining seed.

Injurious though it be, there can be no doubt that the rose-beetle is a very handsome insect, the beautiful golden-green colour of the upper surface reminding one of the tints of many exotic species, so wonderfully refulgent is its character. Across the wing-cases run a number of white streaks and dashes, varying very much in size and number in different individuals, while upon each are several irregular rows of small impressions, looking much as if they had been indented, while the insect was yet fresh and soft from the pupa, by the point of a very blunt pin. The lower surface is of a rich coppery hue, shining with blue and green in different lights, and is clothed with long, golden down, which in some parts is so thick as almost to conceal the body itself from view. The insect is a very plentiful one, and must be tolerably familiar to almost every resident in the country.

While yet in the grub state of development, this beetle is not uncommonly found preying upon the roots of strawberries and other cultivated plants, to which it sometimes causes considerable damage. More generally, however, it resides in the rotten wood of decaying trees, and in such cases, of course, is a friend instead of an enemy, assisting in the

removal of dead and useless matter from the face of the earth, and so clearing the ground for the growth of fresh and healthy vegetation. Now and then it takes up its abode in ants' nests, the legitimate inmates of which, curiously enough, seem in no way to object to its presence, and allow it to remain perfectly unmolested in the security of their stronghold. This is also the case with many perfect beetles, which are treated by the ants as guests, and carefully guarded and protected by them in times of danger.

Grub of Rose-beetle.

Why this should be, no one has as yet been able to discover. That aphides should be found in the nests of ants seems reasonable enough, as they yield a liquid for which those insects have a particular liking. But, so far as we know, the ants utilise their beetle lodgers in no manner whatever, unless, perhaps, they treat them as pets, and lavish their superabundant stores of affection upon them. If this be true, however, it seems curious that certain species should be selected and others passed by. I have tried in vain to induce the ants to receive insects of different kinds as they do their apparently self-invited guests, but without the least success, every specimen which I placed in proximity to the nest being at once attacked and destroyed.

When the grub of the rose-beetle is, in technical parlance, "full-fed," it constructs for itself, at some little depth beneath the surface of the ground, if a

root-feeder, an earthen cocoon about as large as an ordinary walnut, wherein it resides until the time comes round for it to appear in the world as a perfect insect. If an inhabitant of a decaying tree-stump, the chamber is constructed of wood-chips. The beetles generally appear in the months of May and June, at which time of the year they are plentiful almost everywhere. But, singularly enough, their change from the pupal state is made long before, in the depths of winter, the insect still lying packed away in its cocoon until the warm months of early summer induce it to leave its retirement. The same is the case with the common Stag-beetle, which undergoes its final metamorphosis as early as November or December of the season preceding that in which it appears, and is frequently dug up by entomologists when searching for the pupæ of various moths at the roots of trees.

Cocoon of Rose-beetle.

BELONGING to the same family as the rose-beetle, the far more destructive Cockchafer (*Melolontha vulgaris*) next claims our attention.

This beetle, in spite of its great abundance, is not very often seen by an ordinary observer, for it is nocturnal in its habits, and seldom appears on the wing until after the shades of evening have begun to set in. It is then, however, an almost obtrusively conspicuous insect, its heavy, blundering flight, and

the loud humming noise caused by the vibration of the wings, absolutely forcing it upon the notice of the

Cockchafer (*Melolontha vulgaris*).

passer-by. Artificial light seems to have an irresistible attraction for it, as for night-flying insects in general,

and it may often be seen dashing itself against the panes of a gas-lamp, or entering an open window in its endeavours to discover the source of the mysterious flame.

The cockchafer is a bulky, and even a clumsy, insect in form, the limbs seeming scarcely equal to the task of supporting the body. But this is more in seeming than in reality, for every part of the frame is permeated by so close and intricate a network of breathing-tubes that the weight is reduced to the least possible degree.

And this in more ways than one. In the first place, the substitution of breathing-tubes for lungs enables the respiratory apparatus to act with at least equal perfection, and yet detracts from, instead of adding to, the substance of the body. In the next, the blood, the whole of which is simultaneously and continuously aërated, need be far less in quantity than in animals which breathe by means of lungs, as no portion of it is at any time effete, and unable to perform its office, owing to the exhaustion of the contained oxygen. And, thirdly, as the blood need not be brought to a central point when in need of aëration, and sent back, through another set of vessels, when purified, the necessity for veins and arteries is also at an end. An insect, therefore, owing to its peculiar method of respiration, can dispense, not only with lungs, but also with almost the whole of the circulatory system, and requires, moreover, little more than one-half of the proportionate quantity of blood which is necessary in other animals. It is to this wonderful structure that insects owe their great

activity, their astonishing muscular strength, and their almost tireless powers of flight; and, indeed, but for such a provision, it is difficult to see how such species as the cockchafer would be able to fly at all.

Notwithstanding the nocturnal habits of the cockchafer, it must be too familiar to most of us to require special description, and we will therefore at once proceed to discuss its life-history and influence upon ourselves.

There are many insects whose development extends over a series of years, although we see them in their perfect state for but a short period of time. Such, for instance, is the case with the well-known May-fly, or *Ephemera*, on which so much needless commiseration has been thrown away in consequence of the supposed brevity of its existence. It is true enough that its perfect life extends over but a single day, but at least two years have been spent in the larval stage of its development, so that it is in reality far longer lived than the great majority of insects.

The cockchafer, however, is one of the exceptional few, and, in the larval state alone, passes no less than three seasons beneath the surface of the ground. The eggs are deposited deeply in the soil by the parent, and the grubs proceed, immediately upon making their appearance, to the one great object of their lives, namely, that of devouring the largest possible quantity of food in the shortest possible period of time. And this task they accomplish most thoroughly, literally gorging themselves to such a degree that almost the whole of the available space in the body

which is not occupied by the stomach is filled up with stores of accumulated fat.

Clumsy as the perfect beetle is in appearance, the grub is far more bulky and unwieldy, and usually rests in a curved position upon the side of the body, the legs being perfectly unable to sustain its weight. The jaws are large and strong, and by their aid the insect attacks the roots of various plants, which in many cases it eats almost entirely away.

Grub of Cockchafer.

Grass land, in particular, suffers from the attacks of the cockchafer grub, the roots being so completely destroyed that the turf can be rolled up by hand, just as though a spade had been passed beneath it. Crops, too, of various kinds are subjected to almost equal damage, potatoes seeming to be especially liable to the attacks of the beetle.

Were it not for the services rendered to us by certain birds, indeed, our losses from the depredations of the cockchafer grub would be almost incalculable. But the rook, in particular, seems to consider these insects as a special dainty, and extracts them by thousands from the soil in which they have taken up their abode, its keen sense of hearing probably enabling it to detect their presence. In the neighbourhood of the sea-coast, too, various gulls render most efficient assistance in the work of destruction, often following the plough in company with the

rooks in order to obtain the grubs which are turned out of the broken earth.

After three years have been spent in almost continual feasting, those grubs which have escaped their various foes form for themselves earthen cells, and therein assume the pupal form, after the manner of the larva of the rose-beetle already described. Like that insect, too, they attain their perfect condition in the winter months, although, as a rule, they do not appear in the world before the month of May.

But their destructive work is not yet over, for they are fully as voracious as perfect beetles as when they were still in the grub stage of their development. Their ravages, however, are now directed against foliage instead of roots, and such trees as oaks and elms are sometimes entirely denuded of their leaves by the myriads of cockchafers which attack them. This, however, is more often the case upon the Continent than in our own country, the mischief wrought us by the cockchafers, severe though it is, being far inferior to that inflicted upon our neighbours upon the other side of the "silver streak."

An insect very similar to the cockchafer in habits, and not unlike it in appearance, is the June-bug, or Summer-chafer (*Rhizotrogus solstitialis*), which is extremely plentiful towards midsummer in many parts of the country. It is of a less retiring disposition than its larger relative, generally making its appearance almost immediately after sunset, and lazily circling in large companies round various trees in

gardens and elsewhere. So abundant is the insect that it is not at all unusual to see fifty or sixty individuals simultaneously engaged in their aërial evolutions, their easy and yet complicated movements irresistibly reminding the observer of those of a crowd of highly-magnified gnats.

From the cockchafer the June-bug may easily be distinguished by its smaller size, its paler colour, the absence of the curiously curved and pointed tail, and also by the long yellow hairs with which the body is densely clothed. It is true that the cockchafer, when fresh from the pupa, is covered with pale down, but this is neither so long nor so thick as in the smaller insect, and is generally rubbed off in the course of a few days of active life. The two beetles, moreover, are not found simultaneously, the cockchafer vanishing before the June-bug makes its appearance.

Then there is the Smaller June-bug (*Phyllopertha horticola*), sometimes known as the Bracken-clock, which, owing to the fondness manifested for it by certain of the finned inhabitants of the stream, is so dear to lovers of the piscatorial art. By these it is termed the Cockerbundy, a corruption of the Welsh title of Coch-y-bondhu.

This is a remarkably pretty insect, the head and thorax being of a metallic bluish-green colour, and the wing-cases of a bright reddish-brown, the latter being ornamented by rows of punctures similar to those of the rose-beetle.

As its popular name implies, this insect makes its appearance in the perfect state in early summer, and

is sometimes so plentiful as to cause considerable mischief in our gardens and orchards by devouring the foliage of the fruit-bearing trees. Nor does it confine its ravages to the fruit alone, for the blossoms and even the young fruit are equally satisfactory to its far from fastidious taste, and, as a grub, it is nearly as destructive, in proportion of course to its size, to the roots of grass, &c., as is that of the cockchafer itself.

All the foregoing beetles belong to the family known as *Lamellicornes*, or "leaf-horned" insects, which are distinguished by the fact that the club of the antennæ is formed of a series of plates, or leaves, which in most of the species are freely movable at the will of their owner. The number of these plates varies greatly in different species, the June-bug, for instance, possessing but three only, while the cockchafer can boast of no less than seven in the male and six in the female insect. In the former sex, also, the plates are of much larger size, the antenna, when fully spread out, being really a very handsome object.

NEXT we come to the very destructive insects known as Wireworms, which are the grubs of the beetles bearing the popular title of Skipjacks.

This name, in a certain measure, explains itself, and is due to the fact that the perfect beetles possess the power of jerking themselves into the air if they happen to fall in a reversed position upon a level surface. And this owing to the shortness of the legs and the convexity of the body, which together render

the insects very liable to fall over upon their backs, and, moreover, make it a matter of very great difficulty for them to regain their feet when they are unfortunate enough to do so. Upon many occasions, too, the attitude is voluntarily assumed, for, as the skipjacks are neither strong of body nor active of wing and limb, their only defence against their enemies lies in concealment in some form or other, which may enable them to pass unnoticed by their keen-eyed foes. When danger approaches, therefore, the beetles allow themselves to fall to the ground, whereon their resemblance to surrounding objects is in most cases so great that they cannot be detected without much difficulty.

When they wish to regain their feet, they employ a very curious apparatus, scientifically known as the "mucro," which is, in fact, nothing more than a spine formed by the prolongation of the lower surface of the thorax, and fitting into a cavity provided for its reception between the middle pair of legs. This spine is used in the following manner :—

The insect first arches its body as much as possible, so as to rest only upon the head and the extremity of the abdomen, this movement mechanically drawing the mucro from its sheath.

Skipjack-beetle in act of leaping.

The position is then sharply reversed, the mucro springs back into its place, the base of the wing-cases

is driven forcibly against the earth, and the insect thus jerked into the air. While in the act of descending it gives a half-turn of the body, and generally succeeds in falling upon its feet; should it fail to do so, the operation is repeated until success crowns its efforts. A curious clicking sound is caused by the mucro as it flies back into its sheath, which has earned for the insects the alternative title of "Click-beetles."

The family to which the skipjacks belong is a tolerably large one, for even in our own country alone we find that nearly sixty species are represented. Many of these are exceedingly rare, however, and only about one-third of the number are at all commonly met with.

While in the grub state of their development, the skipjacks certainly deserve the title of "Wireworms" which has been bestowed upon them, for the skin is so extremely hard and tough that the insects suffer little more injury when trodden into the earth than would fragments of veritable wire. In form they are curiously slender, and the legs are so short that, unless carefully looked for, they would most probably not be seen at all.

As these wireworms live for no less than five years before assuming the pupal form, and as during the whole of that period they are engaged in feeding on the roots of various crops, it may well be imagined that the damage which they cause is very great, more especially as they devour but little of each plant, and so destroy far more than they actually require for

food. And, unlike insects in general, they are practically omnivorous, as far as vegetation is concerned, for there is scarcely any cultivated plant which is not more or less a sufferer from their attacks. Every year we read of losses caused by the ravages of wireworms, which, owing to the fact that they live entirely beneath the soil, are protected from the various means of destruction which would be brought against them, were they to attack the visible instead of the concealed portions of the crops.

Here, again, as with the cockchafer, we may recognise the inestimable value of the birds which, only a few short years ago, we considered as our direst enemies, and trapped or shot down at every possible opportunity. Take, for example, the much-maligned rook, whose appetite for corn was supposed to be so insatiable that farmers put themselves to great expense in order to drive him from their fields. Not only does his powerful beak extract the grubs of the cockchafer in myriads from their fancied security beneath the soil, but he also destroys the still more terrible wireworms literally by hundreds of thousands, and, ably assisted by the mole, annually saves acres upon acres of our corn and vegetables from total destruction. And this has been so often and so satisfactorily proved, that it is a matter beyond all question or doubt. See what is said by a correspondent of the *Gardener's Magazine*, vol. ix., p. 718 :—

"I have repeatedly examined the crops of rooks: in six young that had been shot the crops were nearly filled with wireworms; in the crops of others I have

found the larvæ of the cockchafer and other grubs that I am not entomologist enough to know the names of. In one or two instances, in frosty weather,—when, of course, wireworms, &c., could not be obtained,—I have examined the crop of one or more rooks that had been shot: it contained dung, earth, and a small portion of grain. I will just notice that the land adjoining Mr. Wiles's rookery is yearly sown with pulse or grain, and in no instance have I known or heard that the land has in consequence failed of a crop."

Mr. Curtis, also, in his work upon "Farm Insects," quotes from a communication to the *Magazine of Natural History*, vol. vi., p. 142, the following remarks:—

"In the neighbourhood of my native place, in the county of York, is a rookery in which it is estimated that there are 10,000 rooks; that 1 lb. of food is a very moderate allowance for each bird, and that nine-tenths of their food consist of worms, insects, and their larvæ; for, although they do considerable damage to the fields for a few weeks in seed-time and a few weeks in harvest, particularly in backward seasons, yet a very large proportion of their food, even at these seasons, consists of insects and worms, which (if we except a few acorns and walnuts in autumn) compose at all other times the whole of their subsistence. Here, then, if my data be correct, there is the enormous quantity of 468,000 lb., or 209 *tons*, of worms, insects, and their larvæ destroyed by the rooks of a single rookery in one year. To every one who knows

how very destructive to vegetation are the larvæ of the tribes of insects, as well as worms, fed upon by rooks, some slight idea may be formed of the devastation which rooks are the means of preventing."

Although not endorsing the writer's remarks upon the mischief wrought by the earthworm, to which creature it would seem that the word "worms" refers, it is impossible not to agree with his main argument that rooks should be ranked as our friends, for his statements are corroborated by those of many other observers sufficiently enterprising to experiment for themselves, instead of blindly accepting as facts assertions which have never been verified. There can be little doubt, therefore, that our wisest policy is, as far as possible, to encourage rooks and kindred birds in our fields, setting the inestimable assistance which they daily render to us against the comparatively unimportant mischief caused by them at certain seasons of the year, and cheerfully submitting to some slight loss in order to obtain a greater good.

At the end of their long period of larval existence the wireworms descend deeply into the ground, and construct for themselves small earthen cells wherein to pass the pupal stage of their growth. It is a somewhat singular, and yet scarcely a surprising fact, that the five years of hard and steady work which the jaws of the grubs have undergone often cause the tips to be completely rounded, and the teeth with which they are furnished to be worn altogether away by the constant friction.

Now, although certain wireworms are so exceed-

ingly injurious, it must not be thought that all are alike in this respect, for the grubs of many skipjacks feed upon rotten wood alone, and so occupy the position of allies instead of that of enemies. Of all the sixty British species, indeed, there are not more than ten or twelve which cause us any appreciable damage, and of these not more than four or five are sufficiently plentiful to call for any special notice. The abundance in which these are sometimes found, however, may be imagined from the fact that one woman alone, who was employed for the purpose of "hand-picking" some infested turnips upon a farm at Hounslow, collected no less than 41,600 grubs in the course of seventeen days' work.

Perhaps the most common, and consequently the most destructive, of the noxious species is a skipjack, not possessing a distinctive popular name, but known in science as *Agriotes lineatus*. This is by no means a large insect, seldom, if ever, exceeding the third of an inch in length, and may at once be distinguished from all its kin by the fact that each of the wing-cases is adorned with four longitudinal dark stripes upon a ground of yellow-brown, the head and thorax being almost black. Upon close examination, it will be seen that the whole of the upper surface of the body is covered with recumbent greyish down, and that the dark streaks on the wing-cases are bordered by rows of rather deeply impressed punctures. In general appearance the beetle is decidedly clumsy, and is very awkward when crawling upon a level surface, the body being dragged over the ground in a manner

strongly suggestive of the slow and ungainly movements of an alligator or crocodile.

A second species, *Agriotes obscurus*, is a larger and more stoutly-built creature, of an almost uniform dull-brown hue. This also is clothed with greyish down, and the wing-cases exhibit the rows of punctures noticed with regard to the preceding insect, although they do not in this case border stripes of a darker tint.

Plentiful though these two species are, they are comparatively seldom seen by a casual observer, being lovers of darkness, and concealing themselves beneath stones, clods of earth, &c., during the hours of daylight. An insect far more generally familiar is that known by the somewhat lengthy title of *Athōus hæmorrhoidalis*, whose habits are directly opposed to those of its nocturnal relatives. Instead of hiding itself away during the hours of day, it literally revels in warmth and light, and may be seen in numbers resting upon leaves and flowers, or flying to and fro in the sunshine upon any fine morning in spring and early summer, its slow movements and outspread wing-cases rendering it a very conspicuous object.

Besides the grubs of the true skipjacks, there are many other creatures which are considered by agriculturists as wireworms, chief among these being the grubs of the Crane-fly, or Daddy-long-legs, which will be treated of hereafter, and the various centipedes and millipedes which are so plentiful in all parts of the country. The true wireworms may be easily known from the false by the fact that they possess

six legs, situated close to the head, whereas the crane-fly grubs are altogether limbless, and the centipedes and millipedes are furnished with legs upon all the segments of which the body is composed.

As regards the various destructive agents whose use has been recommended in cases of wireworm attacks, it would seem that very few are of any real service, for the insects lie so deeply beneath the surface of the ground as in many cases to be entirely unaffected by these so-called "remedies." By far our best hope, in dealing with them, lies in the encouragement of the mole and the various insectivorous birds, to which Nature has given the power of performing work which we cannot carry out for ourselves, and which are only too ready to act as our assistants, if we will but allow them to do so.

CHAPTER VII.

RHYNCHOPHORA, OR WEEVILS.

Weevils, and their abundance—Characteristics of the group—The beak and the "elbowed" antennæ—Small size of British weevils—Naturalised foreigners—*Otiorrhynchus tenebricosus*—Its beauty of form—Injurious character—Life-history—*O. sulcatus*, and its habits—*O. picipes*—Its scale-covered body—Abundance of the perfect beetle—*Barypeithes brunnipes* in strawberry-beds—An *Otiorrhynchus* in miniature—The *Sitones* weevils—Their abundance and destructive habits—Simulating death—*Sitones lineatus*—A lively scene in the "sweep-net"—Ravages of the insect—The *Orchestes* weevils, and their powers of leaping—Destructive character—*Orchestes alni* in 1879—The Nut-weevil, and its habits—The tenant of a "bad" nut—Beauty of the nut-weevil—*Anthonomus pomorum*—Life-history—Apions—Similarity of the different species—Their abundance and destructive character.

We have now to deal with a very large and important family of beetles, which in tropical lands attains to enormous dimensions, and which, even in our own country alone, numbers some five hundred and thirty species. Popularly these beetles are known as Weevils, and scientifically as *Rhynchophora*.

The last of these titles is a very appropriate one, signifying "snout-bearing," and referring to the singular prolongation of the head into a kind of beak, or proboscis, which is one of the special character-

istics of the family. Like all important structural features, this beak varies very much in different members of the group, being sometimes long, sometimes short, sometimes slender, sometimes stout, and so on, its form and size, of course, being always dependent upon the requirements of the individual species to which it belongs. At the extremity of the beak is situated the mouth, the antennæ as a rule also springing from its sides, and lying packed away beneath it when not in use.

In the generality of weevils these organs are "elbowed," the first joint being of such extreme length, in comparison with the remainder, as apparently to divide the antennæ into two distinct portions. The last few joints are so compactly placed, and are so much larger and broader than those preceding them, that they form a distinct and almost solid club, generally of an oval or pointed form. Yet another distinguishing feature may we find in the feet of these beetles, the third joint of which is usually bi-lobed, while the three basal joints are furnished with a thick pad upon their lower surfaces. In the majority of weevils these characters are so strongly marked as at once to point out the family to which the insects belong, and there are indeed very few species whose position in the order even a casual glance would be insufficient to detect.

Few of our British weevils attain to any great size, the largest of them scarcely reaching the length of two-thirds of an inch, while many are so minute that the use of a magnifying-glass is necessary almost

before they can be seen at all. As we have already found in the case of the aphis, however, the dimensions of an insect have but little effect upon the magnitude of its work in the world, numbers more than compensating for individual want of strength and size, and rendering the most insignificant beings collectively of far greater importance than many which are immeasurably superior to them in point of bodily development. And, as with the aphides, so with the weevils, which, in combination, exert a very powerful influence upon man's well-being in the world.

And this influence, unfortunately, in most cases affects us adversely. Those weevils whose life-history has any direct bearing upon ourselves are generally, although not invariably, our enemies, finding their food in our crops, both before and after they are gathered in, and so causing to us the annual loss of a large proportion of our produce. And many of these are the more injurious in that their work is carried on in secret, its evil effects being only apparent when the mischief has proceeded too far to be arrested.

Of the weevils found in this country, it is undoubtedly the fact that a large proportion are not indigenous inhabitants at all. Civilisation, while it has extirpated many members of our native *fauna*, has replaced the loss, not always advantageously, by the introduction of foreign species, some of which have been deprived by climatic influences of the power of propagating their kind, while others have suited themselves to the altered conditions of their life, and spread themselves over all parts of the

country. There is scarcely a vessel which enters our docks but brings with her a greater or less number of foreign insects. We import them in our timber, we import them in our grain, we import them in goods of almost every description, and so our commerce with other parts of the world is undoubtedly the primary cause of much of the damage annually wrought us in our own country by insect agency. The wonder, indeed, is, that a far larger number of exotic species should *not* have become naturalised, rather than that a comparatively small proportion of the frequent immigrants should have taken up their abode with us.

FIRST upon our list of destructive weevils comes a species distinguishable by its size alone from the majority of its fellows, a large specimen being more than half an inch in length, and being correspondingly bulky in bodily form. This beetle, which, in common with insects in general, is distinguished by no generally accepted popular title, is known scientifically by the somewhat lengthy title of *Otiorrhynchus tenebricosus*, and is a member of a genus containing nearly twenty British species.

This is one of the many beetles which, although of decidedly handsome appearance, owe their beauty more to the elegance of their form than to the tints or markings of their bodies. Head, thorax, and wing-cases are alike of a deep black hue, and the only approach to colour is in the legs, which are of a dull reddish-brown, and in a light golden down which

adorns certain portions of the elytra while the insect is yet fresh from the pupa. The shape of the body, however, is decidedly graceful, the long and slender antennæ, the pointed oval abdomen, and the long legs, with their stout thigh-joints, giving to the insect a peculiarity of appearance which, when once seen, is scarcely likely to be forgotten.

This beetle, like the cockchafer, is injurious both in the larval and the perfect stages of its existence, feeding as a grub upon the roots of gooseberries, raspberries, currants, strawberries, and various garden vegetables; and as a perfect beetle upon the young leaves and shoots of peach, plum, and apricot-trees, more especially in those which are trained against walls. In certain seasons the insect is sufficiently plentiful to cause no little damage, annoying enough in the kitchen-garden, but doubly so when large fields of produce are injured or even destroyed by its attacks.

The life-history, so far as is at present known, can be told in few words.

The eggs are laid beneath the surface of the ground, the young larvæ making their appearance towards the beginning of August. The life of these is of an entirely subterranean character, the grubs feeding upon roots alone, and not leaving the soil until after they have assumed the perfect form. About the month of April in the following year the change to the pupal state takes place, the beetles themselves emerging four or five weeks later.

Almost equally destructive with this weevil are two

of its congeners, known respectively as *Otiorrhynchus sulcatus* and *O. picipes*.

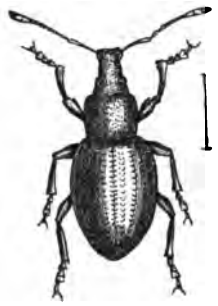
The former of these is a somewhat smaller species, prettily marked with orange upon a black ground, and with deeply-furrowed wing-cases. Upon close examination with a powerful magnifying-glass, the orange patches are seen to be composed of small tufts of golden down, and the interstices between the furrows, as well as the whole of the thorax, to be strongly granulated, the beauty of the insect being consequently greatly increased.

Like its larger relative, this beetle is very destructive in gardens, and, while in the larval state, shows a decided preference for potted plants, whose stems it eats away just below the surface of the earth. The body of the grub is covered with short, stiff bristles, by the aid of which it is enabled to work its way through the soil, just as does a snake upon the ground by means of its scales.

The latter insect is very much smaller, and is generally exceedingly abundant throughout a great part of the year. Unlike the two preceding insects, it is scale-covered upon the whole of the upper surface of the body, to which fact are due the pretty dark marblings with which the pale brown wing-cases are diversified.

The scales in question are arranged in rather a singular manner, being set in a number of small figures of a roughly-circular form, which are placed closely together, and in many cases almost run into one another. Each of these figures encloses either one

or two separate scales, which, like those surrounding them, are almost circular in shape. Upon the thorax the scales are much smaller, and are placed in the interstices between the granulations.



Otiorrhynchus picipes.

As far as my own experience goes, this is one of the most plentiful of British beetles, and is of a wonderfully ubiquitous character, making its appearance in all sorts of unexpected situations, and appearing at times when one least expects to find it. It is not very fond of feeding by daylight, and mostly conceals itself in some convenient retreat until darkness has fairly set in, when it issues forth upon its errand of destruction. Like the two preceding insects, it is very injurious to many cultivated plants, and I have found it in quantities at night feeding upon the leaves of the common bramble.

There is a curious little beetle, termed *Barypeithes brunnipes*, which looks absurdly like a pale-coloured *Otiorrhynchus tenebricosus* viewed through the wrong end of an opera-glass. The body is rather more strongly oval, however, and the elytra are marked with several rows of large and deep punctures.

This is a very common species throughout a considerable portion of the year, and occurs in a great variety of situations, from decaying wood to straw-

berries. Its attacks upon the latter plant, curiously enough, do not hitherto seem to have been noticed, although, in some neighbourhoods, at any rate, it causes considerable damage. I have found a bed of strawberries so infested by the insect that every fourth or fifth berry was more or less devoured, the insects eating small circular holes into the fruit, and often penetrating almost to the very heart. I noticed that in almost every case the burrow had been commenced from beneath, the beetle creeping under the berry as it rested upon the ground, and then tunnelling upwards. Whether the larva was equally destructive I was unable to ascertain.

ALL who have ever devoted themselves to the culture of peas and beans must be unpleasantly familiar with a number of little grey and brown weevils which are classed together under the generic title of *Sitones*, and which are only too plentiful in all parts of the country. Clover sometimes literally swarms with them in the early part of the year, and in a very short time shows evident signs of the character of its unwelcome guests.

The attacks of these beetles are directed towards the leaves, which are eaten gradually away from the edges to the centre, and are sometimes so completely destroyed that nothing but the mid-rib is allowed to remain. As a general rule, the insects commence their ravages in the month of April, or in some cases even earlier, and, attacking the plants while still young, do an immense amount of damage by stripping

them of their leaves. They are day-feeders, unlike many destructive insects, and, indeed, seem to feed without cessation throughout the twenty-four hours, their destructive habits being carried on equally by day and by night.

Owing to this fact, it might well be thought that these weevils could be captured without any very great difficulty, and that therefore a little attention paid to an infested crop would generally be sufficient to check the attack. But this is not the case, for the beetles are extremely wary, and allow themselves to fall to the ground at the first sound of an approaching footstep, not attempting to stir a limb until the danger may be considered to have passed away. While thus simulating death, their sober hues harmonise so well with those of the soil, and the insects are so small and lie so perfectly without motion, that it is next to impossible to detect them, and they are thus enabled to escape in many cases in which more conspicuous species would certainly be seen and destroyed.

Perhaps the most plentiful of these weevils is a rather variable insect known as *Sitones lineatus*, which is exceedingly abundant during spring and early summer, and again in the months of autumn. I have sometimes taken it in such profusion by means of the implement known as a "sweep-net," that the interior of the bag seemed to be literally alive with the little beetles, which, when once their first alarm was over, began to crawl rapidly in all directions, in the hope of escape, and almost bewildered me by their

extreme abundance. The ground-colour of this species is black, but both the upper and under surfaces of the body are thickly clothed with scales of various shades of brown and grey, which are so disposed upon the wing-cases as to form a series of longitudinal stripes of alternate dark and light hues, by which the insect may be readily distinguished from most of its fellows.

Sitones lineatus.

Mr. Curtis tells us that he has seen this insect in such excessive abundance that, in a field of broad-beans many acres in extent, he was unable to find a single leaf whose edges were not more or less eaten away by the weevil. He also quotes from a letter received by him during the same year (1843), the writer of which, speaking of a large field of peas, states that the beetles fell from the plants in such profusion upon the approach of a footstep that a sound like that of rain was caused by their bodies as they struck the leaves in their descent.

A second brood of this beetle occurs towards the end of the summer, in August or the beginning of September, when the insects transfer their attentions to the clover and lucerne crops, and sometimes damage them very greatly. In spite of the numbers of these weevils, however, we are almost wholly ignorant of their earlier life-history, and can only suppose that the eggs are deposited in the ground,

and that the grubs, like those of the *Otiorrhynchi*, are root-feeders.

THE curious little weevils belonging to the genus *Orchestes* deserve a word of mention, in consequence of the damage which they occasionally cause to the leaves of our forest-trees. The oak and the elm, for instance, are sometimes so severely attacked that almost the whole of their foliage is withered, the trees themselves, of course, sustaining no little amount of indirect injury.

These are all small beetles, most of them being scarcely more than one-tenth of an inch in length, and may be known from almost all other weevils by their astonishing power of leaping. When disturbed or alarmed in any way, they are literally as active as so many fleas, skipping about with wonderful rapidity, and eluding all attempts to capture them, unless when taken by surprise. This power they owe to the extraordinary strength of the hinder legs, the thighs of which are greatly enlarged, in consequence of the development of the muscles within, just as is the case with the corresponding limbs in the case of the kangaroo, the jerboa, and other leaping mammals.

The injuries caused by the *Orchestes* weevils are principally due to the grubs, which burrow into the leaves, and feed upon the soft and pulpy portion which lies between the upper and the lower surfaces. A very common species, known as *Orchestes alni*, infests the elm, and in the year 1879 was excessively abundant in some parts of the country, notwith-

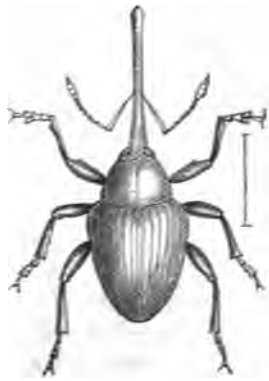
standing the prevailing scarcity of insect life. Mr. E. A. Fitch has told us that the foliage of most of the elm-trees in the neighbourhood of Malden, Essex, appeared to have been completely scorched, so withered were the leaves in consequence of the havoc caused by the grubs. The perfect beetle may at once be known by the bright chestnut-brown colour of the upper surface, and the large black spot upon the suture of the wing-cases; the legs and the lower parts of the body are black.

Another species, *O. fagi*, which is of a narrower build and is entirely black, is found upon the beech, the leaves of which it perforates exactly as does the preceding insect those of the elm. When closely examined, the wing-cases of this beetle are seen to be covered in places with delicate down, which in some examples is of a red and in others of a green hue. The insect is a very plentiful one.

Our next example of the noxious weevils is an insect of very different character, the result of whose work is probably more generally familiar to most of us than the beetle itself. This is the common Nut-weevil (*Balaninus nucum*), a rather large and handsome species, which appears in the perfect state at the beginning of summer, and is very plentiful in woods at that season of the year.

Doubtless most of my readers have at some period of their existence gained practical experience of the peculiarly nauseous flavour of a bad nut. If so, they may lay the blame upon the nut-weevil, which

had placed her egg in the immature fruit, and thus doomed it to destruction by the grub, which devoured the kernel, and left in its place nothing more than a mass of semi-putrid *débris*. If the nuts are opened while still unripe, the larva may often be found in the form of a fat white maggot furnished with a pair of strong black jaws. As soon as its growth is completed, the insect gnaws a circular hole through the shell of the nut and allows itself to fall to the ground, in which it buries itself before assuming the pupal form. This operation, however, it does not perform at once, passing the winter still as a larva, and only undergoing the remainder of its transformations in the ensuing spring.



Nut-weevil
(*Balaninus nucum*).

There are several British species of nut-weevils, which devote their attention both to the filbert and to the hazel-nut, and the most familiar of which is that mentioned above. It is an exceedingly handsome insect, both in form and colour, the general hue being a rich tawny brown, diversified with sundry black markings upon the thorax and wing-cases, and the whole of the upper and lower surfaces being covered with long, hair-like scales, which

extend even to the tips of the antennæ and the claws. Down the centre of the thorax runs a whitish line, which, on close inspection, is seen to be the point from which the scales diverge to either side, and gives one very much the idea of the parting upon a head of hair. The length of the beetle, when the beak is fully extended, is nearly half an inch, and as

Nut-weevil and Larvæ (*Balaninus nucum*).

the body is fairly stout in proportion, it is a tolerably large insect.

Another, but a much scarcer species of nut-weevil (*B. tessellatus*) is remarkable for the extreme length of the beak, which in many specimens is greater than that of the entire body. As it is considerably curved, however, this fact is not so noticeable as it would seem by mere description.

ALLIED to the nut-weevil, although belonging to a different genus, we have another fruit-destroyer in the shape of the really beautiful beetle known as *Anthonomus pomorum.*

This is quite a small insect, being only about the sixth of an inch in length, but the colouring is so striking and handsome that the weevil would attract far more notice than many of larger size. The head and thorax are closely covered with hair-like scales of various tints, ranging from silvery white to a rich tawny brown, while the wing-cases are chestnut red, with an oblique white band crossing them towards their apical extremity. This band, which in some specimens is more distinct than in others, is narrowly bordered with black, rendering the contrast of colours far more effective, and clearly defining the space allotted to each. The "scutellum," a small triangular organ in the centre of the base of the wing-cases, is also covered with white scales, and the thighs of the front pair of legs are furnished with a large and conspicuous tooth, the object of which is very uncertain. Unfortunately, the scales, on which the beauty of the insect is, of course, dependent, are very loosely attached to the body, and, unless the beetle be captured when freshly emerged from the pupa, it is not easy to obtain a really perfect specimen.

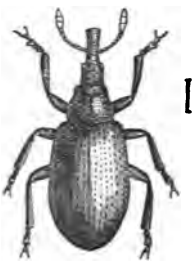
Anthonomus pomorum.

As its name implies, this weevil attacks the flowers of the apple, not on her own account, but on that of her future young. Shortly before the buds burst she makes her appearance, perforates a hole, by means of her long proboscis, to the very centre of those she selects, and in the heart of each deposits a single egg. Before very long the grubs hatch, devour the interior of the bud and the greater part of the immature fruit, and then change to the pupal state, the perfect insects emerging towards the middle of June. The infested buds may easily be detected by the fact that they do not open with the rest, and lose their beautiful tints very shortly after the grub has begun its work of destruction.

A WORD of mention is required for the curious little *Apion* weevils, of which nearly eighty species have been found in Great Britain, and some of which are very destructive to clover crops. They are all of very small size, many being scarcely as large as an ordinary note of admiration, and as a general rule are so very similar to one another that none but an experienced eye can distinguish between them. There are but few of our British beetles more troublesome to separate into species than these *Apion* weevils, many months of careful study being necessary in order to master the differences between them. This difficulty, of course, is principally due to their very small size. Our largest species of *Apion* is but one-sixth of an inch in length, and is a very giant among his kind, the generality of his

relatives boasting of barely one-half his dimensions. Then the colouring is so similar in most of the species, and the points of difference are so few, that it is only by taking note of such details as the density of the punctures upon the head and thorax, the length and shape of the beak, and the comparative size of the different joints of the antennæ, that the entomologist can hope to succeed in his task. There are, it is true, some few exceptions to this rule, for several of the species, when once seen, can be easily distinguished from all their kin. But by far the larger proportion are so wonderfully alike, that the greatest care is necessary when it is required to relegate them to their respective positions in the cabinet.

The body of an *Apion* is always more or less oval in shape, and the beak long and slender, while the insects have altogether so characteristic an appearance that they can scarcely fail to be recognised by any one who has ever noticed them, even though their colours are almost invariably limited to the hues of green, blue, and black.



Apion carduorum.

Some of the species of *Apion* are exceedingly abundant, and occur in the greatest profusion upon clover and vetch crops, devouring both the leaves and the seeds, and often causing considerable damage. As many as a hundred specimens have in some cases been found feeding upon a single leaf.

CHAPTER VIII.

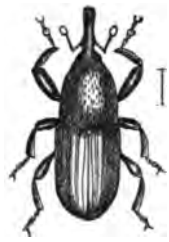
GRANARY WEEVILS, TURNIP-FLEAS, ETC.

Granary weevils and their ravages—The Corn-weevil and the Rice-weevil — Their life-history — Immense abundance—Imported grain and its insect inhabitants—*Ceuthorrhynchus sulcicollis*—Its destructive character—Life-history—Appearance of the perfect insect — Its habit of simulating death — Peas and beans and their enemies — *Bruchus* weevils—History of their life—*B. rufimanus*, and its beauty —The Asparagus-beetle—Its exquisite colouring—Abundance in kitchen-gardens—Life-history of the asparagus-beetle — A near relative — The Turnip-flea — Its terribly destructive habits—Origin of its popular title—Activity of the turnip-flea—Its life-history—How the attack is made — Means of prevention — *Phyllotreta lepidii*—*Plectroscelis concinna* in the hop-gardens—Summary.

AMONG the many species of insects not indigenous to this country, but which have become naturalised in consequence of their frequent importation, are the two terribly destructive beetles known respectively as the Corn and the Rice Weevils (*Calandra granaria* and *C. oryzæ*), which annually cause to us losses of almost incalculable extent.

The former of these is a cylindrical, deep-brown insect, about one-seventh of an inch in length, with a short and stout beak, and remarkably powerful limbs. The thorax is sprinkled with large and deep punctures, and the wing-cases are traversed by several

longitudinal furrows. The Rice-weevil is somewhat similar in general appearance, but is a smaller insect, with more closely-punctured thorax, and with two red spots upon either wing-case, one of which is placed at the shoulder, and the other rather behind the middle. As the life-histories of these two insects are of very much the same character, we will consider them together, remembering, however, that the one species is, as its name implies, more especially attached to rice, and the other to corn in general.



Corn-weevil (*Calandra granaria*).

Both these beetles belong to the class of destructive insects whose work begins after the grain is gathered in, and which must therefore be sought and dealt with in our granaries, and not in the open air. They also exemplify the vast power which can be exerted by a minute and even insignificant insect when present in great abundance, and that in almost as great measure as the very aphis itself.

The allowance of a single grain of corn for the subsistence of an insect during the whole of its larval existence seems little enough, and it would hardly be thought that a being whose requirements are so limited could possibly be the cause of any particular damage. But, when we read that the damaged corn in our storehouses may often be estimated by scores of tons, we gain some little idea of the extreme pro-

fusion of the beetle which, with powers so insignificant, can perform work of such terrible magnitude.

The life-history is simple enough. The female beetle perforates a grain of corn with her proboscis, and introduces into the burrow thus formed a single egg. A second grain is then treated in a similar manner, and so on, until her entire stock of eggs is deposited. The grubs shortly emerge, in the shape of short, stout creatures with two recurved hooks at the extremity of the body, devour the whole of the interior of the grain, assume the pupal form without leaving their abode, and in due course of time emerge as perfect beetles, to make provision for a future generation. The exterior of the damaged grain is almost uninjured, and, except by the difference in weight, it is not very easy to separate the infested from the sound, unless the whole be thrown into water, when the damaged portion, of course, will rise to the surface, owing to its superior lightness.

Some of the statements which have been made with regard to the ravages of these weevils seem almost incredible, but are nevertheless genuine and well-authenticated facts. In one case ten hundredweight, not of weevilled corn, *but of the insects themselves*, were sifted, or "screened," from seventy-four tons of Spanish wheat. More astonishing still, upon another occasion a ton and three-quarters of weevils were sifted from one hundred and forty-five tons of American maize. From a parliamentary report "On Indian Wheat," by Dr. Forbes Watson, we learn also that, out of eleven hundred and fifty-two samples

received, less than five hundred were in an altogether sound condition.

In the case of imported grain, of course, the mischief is generally done before it reaches our shores, and measures of prevention are of comparatively little avail. Our own storehouses, however, are largely infested by the insects, and our best policy would seem to lie in the ruthless destruction of all damaged corn, and in the device of methods of attack, with regard to importations, which shall come into operation before the cargo is placed on board the vessel. Were such a system universally adopted, the insects might be almost stamped out as injurious species in the course of a few years, or, at any rate, their numbers so greatly reduced that their ravages should no longer cause us any appreciable loss.

THERE is a curious weevil, known by the somewhat lengthy title of *Ceuthorrhynchus sulcicollis*, which is apt to cause considerable mischief to turnips while in its grub state of existence, by feeding upon the roots, and so damaging the health of the plants. The method in which it sets to work, however, is perfectly different from that affected by root-feeding insects in general, a gall-like growth surrounding each grub, and increasing in size with the growth of the plant.

The egg is placed in the root by the parent, who pierces a hole for its reception by means of her long proboscis, just as is done in the nut by the nut-weevil. The gall-like excrescence quickly forms, and the grub lies in the centre, feeding therein until the

time comes round for it to assume the pupal form. The damage which it causes is of rather a peculiar character. The leaves do not wither, and the roots suffer no diminution in point of size, being, if anything, increased in dimensions by reason of the swellings which indicate the presence of the insect. But the substance of the bulb loses its natural character, and becomes tough and woolly, perfectly unfit for human consumption, and distasteful and unwholesome to cattle. Happily, however, the beetle is not sufficiently abundant to cause any widespread damage, and, as a general rule, the plants suffer in part only from its ravages.

When the grubs are fully fed, they leave the roots and burrow into the soil, wherein they construct for themselves small earthen chambers in which to pass their pupal existence. Unless very carefully sought for, these cocoons would certainly be passed by, for they are formed merely of small fragments of earth, &c., fastened together by means of a glutinous fluid exuded for that purpose, and are consequently so exactly similar in appearance to the surrounding soil that only an experienced eye would be likely to detect their true character. In these little chambers the insects lie motionless for about two months, and then make their appearance in the world as perfect beetles.

The insect is a very small species, its total length being scarcely one-eighth of an inch, and the body scarcely equalling in dimensions a No. 2 shot. Both the legs and the beak are long, but are tucked away

so compactly when their owner is alarmed that the insect would scarcely be recognised as a living being, more especially as it lies perfectly motionless for some little time. The upper surface of the body is of a deep-black hue, the thorax being strongly punctured, and the wing-cases traversed by a number of longitudinal furrows, each of which is marked with several tolerably large indentations. The lower surface is also black, but is thickly covered with greyish scales.

Although it shows a decided preference for the turnip, this weevil is frequently found infesting the common cabbage, whose roots it causes to swell in precisely the same manner. As, however, the leaves are little, if at all, affected by its proceedings, it is scarcely the cause of any real damage.

PEAS and beans are often great sufferers from the attacks of certain weevils belonging to the genus *Bruchus*, which perforate the seeds while the pods are quite young, and deposit an egg in the centre. The grub hatched from this egg devours a great part of the interior of the seed, and assumes the perfect form in the autumn, not appearing as a perfect beetle, however, until the following spring. Before throwing off the larval skin, it cuts a circular hole as far as the outer shell of its habitation, so that it may find no difficulty in emerging when the time comes round for it to make its appearance in the world. Judging by my own experience, a groove is even cut in the shell itself, so that the trap-door, so to speak, may give way upon the slightest pressure from the beetle

within. It is by no means uncommon to find peas and beans reduced almost to mere empty husks, a round aperture showing that the destroyer has made its exit. In almost all such cases some species of *Bruchus* has been the delinquent, that known as *B. rufimanus* being, perhaps, most frequently in fault.

This is a stoutly-built and rather clumsy insect, and is yet decidedly handsome, being about a quarter of an inch in length, of a dull greyish-brown hue, variegated with divers black and white markings. There is always a white spot in the centre of the base of the thorax, the anterior part of which is thinly sprinkled with whitish hairs. A badly-defined and interrupted bar of grey crosses the centre of the wing-cases, and in the middle of this bar are generally four small spots of pure white, and two, rather large, of deep black, these latter being due to the absence of the hairs with which the remainder of the elytra is closely covered. The first four joints of the antennæ and the whole of the fore-legs are red, the hinder limbs being black and covered with fine grey down.

Bruchus rufimanus.

It is a curious circumstance that the *Bruchus* seems to refrain from devouring the vital germ of the pea or bean in which it has taken up its abode, so that the infested seed will often sprout when placed in the ground. The result, however, seems always to

be a more or less diseased plant, and, according to several accounts, the produce of such seed is most unwholesome if used as food by either man or beast. This latter statement, however, needs confirmation.

Many of our British *Bruchidæ* are undoubtedly introduced, and have no claim to the title of indigenous inhabitants of the country. Almost every consignment of beans and peas which reaches us from abroad brings with it a greater or less number of the insects, and it is little to be wondered at if, such being the case, they should find a permanent home among us. The damaged seed, however, can always be separated from the sound by an experienced eye, the small circular portion through which the enclosed beetle will make its exit being of a different colour to the remainder, and thus testifying at once to the presence of the insect within.

Several of the species may be found in the months of spring upon the common furze, the seed-pods of which they attack just as has been described with regard to the peas and beans. They are among the earliest of insects to appear, for the eggs must, of course, be laid while the seeds are yet in their infancy, in order that the grubs when they emerge may find their food in a soft and fresh condition. In some forward seasons, therefore, the *Bruchi* may be found at work in the warmer days of February, while they seldom delay their appearance beyond the month of March.

PASSING from the weevils, we turn to the large family

of the *Chrysomelidæ*, which includes some of the most beautiful of all our British beetles. Exquisite as they are, however, many of these are very destructive, the common Asparagus-beetle (*Crioceris asparagi*) being familiar to all gardeners as a noxious insect.

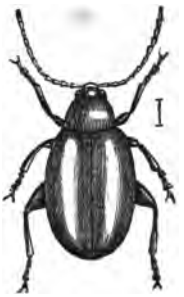
This is an exceedingly pretty creature, about one-fifth of an inch in length, with a bluish-green head, a blood-red thorax, and dark-green wing-cases, each of which has a red side border and three spots on the disc of whitish-yellow. These spots are very variable in size, and often run into one another, one of my own specimens having them confluent upon one side and not upon the other.

This beetle is only too plentiful in gardens in which its food-plant is grown, and may be seen in numbers clinging to the stems and the feathery branches of the asparagus whenever the weather is fine and warm. The eggs are small, dark, skittle-shaped objects, and are fastened by one extremity to the sprigs or the unopened flower-buds, the grubs feeding upon the leaves and the young shoots of the plant. The growth of these grubs, which are of a dark slaty-grey colour, is very rapid, for they are full-fed at the end of a fortnight or three weeks, and then descend into the ground in order to assume the pupal form. Before throwing off the larval skin, however, they spin for themselves small cocoons, of a parchment-like character, and lie in safety therein until they make their appearance in the world as perfect beetles. This they do in the course of another fortnight or so, the entire development, therefore, extending in summer

over a period of little more than five or six weeks. There are two or three broods in the course of the year, the members of the last appearing about the middle of September.

An allied species, *Crioceris merdigera*, infests the flowers of lilies, upon which the larva feeds, but is so scarce in this country as hardly to merit the title of an injurious insect.

Not so our next example of this family, the notorious Turnip-flea (*Phyllotreta undulata*), which is so extremely destructive to the vegetable after which it is named, and which, even so long ago as the year 1786, has been known to cause damage to the extent of more than £100,000 in a single season, and in one county (Devonshire) alone. Upon the presence or absence of this insect, indeed, the welfare of our turnip crops almost wholly depends, for, if the beetle appear in any great numbers, the fields will be stripped in the course of a very few days.



Turnip-flea (*Phyllotreta undulata*).

Like most of the *Chrysomelidæ*, the turnip-flea is a very pretty insect, the ground-colour being brassy black, and a broad yellow streak running longitudinally along either wing-case from the base almost to the apex. It is quite a small species, the body being scarcely more than one-twelfth of an inch in length.

Upon glancing at one of these beetles, it will be at once seen that the thighs of the hinder limbs are much thickened, and that these limbs are of great comparative length. It is to this structure that the turnip-flea owes the wonderful power of leaping which has earned for it its popular title, and which renders it little, if at all, inferior, as regards its saltatory accomplishments, to the insect from which it takes its name. At each bound this little beetle covers, upon an average, no less than eighteen inches of ground, or, in other words, two hundred and sixteen times its own length—much the same as if a man six feet in height were to spring to a distance of a quarter of a mile at a single leap. The actual length of the bound, indeed, is even greater than this, for the insect always rises to some little height from the ground, and so describes an elliptic, and therefore a longer course.

The activity of the turnip-flea, too, is something wonderful. The bounds follow one another with the most astonishing rapidity, the insect hardly touching ground before again rising into the air, and a space of eight or ten yards being often covered in the course of a few seconds. If the beetles are at all numerous, it is really a most curious sight to watch them when disturbed, the air immediately above the turnips being almost full of the little creatures as they skip actively along in order to avoid the impending danger.

There are several species of turnip-flea, of which the above is by far the most plentiful. It may at once be known from its congeners by the fact that

the yellow streak upon the wing-cases is straight, excepting at the extremities, and that the legs are principally black, the knees alone being of a pale yellow colour.

The life-history of these beetles is in some respects very different from that of any of the insects with which we have had hitherto to deal.

It is a curious fact, for instance, that the eggs, notwithstanding the wonderful multiplicatory powers of the beetle, are yet comparatively few in number, and are laid separately, the beetle seldom depositing more than one, or two at the most, in the course of a single day. They are affixed to the leaf of the turnip, which they much resemble in colour, and hatch in about ten days, the little grubs at once burrowing into the leaves, and feeding between the upper and lower surfaces. While the leaf is green but little damage is visible, the track of the larva being apparent only when the colour begins to fade. At the end of little more than a fortnight, the grubs leave the plants and bury themselves a couple of inches deep in the soil, always choosing a spot sheltered from rain by the leaves above, and there undergo the change to the pupal form. Two or three weeks later, according to the state of the weather, the perfect beetles appear, and almost immediately begin to provide for a future generation. In this way six or seven broods follow each other in quick succession from early spring to late autumn, the members of the last generation concealing themselves beneath the bark of trees, in the hollow stems of withered plants, and sometimes even

in fungi, by way of a winter retreat. Early in spring they reappear, and, until the turnips are in leaf, devote their attention to various cruciferous plants, the cabbage, the charlock, or wild mustard, and the hedge-mustard, being especial favourites. These, however, are almost wholly deserted as soon as the first leaves of their normal food-plant appear above the ground, and the beetles at such times may often be seen in myriads flying in the direction of the turnip-fields. It would seem that they discover the whereabouts of their food by the exercise of their sense of smell, as it has been noticed that they always fly against the wind, which, of course, would bring the odour towards them.

The perfect beetle is even more destructive than the grub, attacking the two first smooth leaves, or "cotyledons," of the plants, and piercing them so repeatedly as in greater or less degree to check their growth. The rough outer leaves, also, are generally drilled in multitudinous places, the apertures dilating as the plant increases in size, and sometimes attaining to considerable dimensions, so that, when the insect is plentiful, the crops are almost wholly stripped of their leaves. Numberless means of prevention have been tried, generally with indifferent success; and, as in most cases, it would seem that the only policy of any real value lies in the plentiful manuring of the plants, in order that they may quickly attain both size and strength, and so be enabled to set comparatively at defiance the attacks of the beetle and its almost equally mischievous grub. A backward crop nearly

always suffers more greatly than one the growth of which has been rapid, affording us positive proof that this is really the case.

Another species of turnip-flea, *P. lepidii*, is very common in some districts, and is of an uniform bright green or blue colour, and of rather narrower form than the insect already described. I have taken it almost in pints in a field of Swedish turnips near Croydon, by brushing a hand-net backwards and forwards among the plants.

An allied insect, *Plectroscelis concinna*, which is of an uniform brassy-green hue, with several longitudinal rows of large punctures upon the wing-cases, is sometimes destructive in hop-gardens, feeding upon the young shoots in early spring, and, later on in the year, upon the cones, which the grubs reduce to a perfectly worthless condition. As a general rule, however, the insect is not sufficiently plentiful to cause any great amount of damage.

WITH this insect closes our account of the British beetles which have been proved injurious to our interests, some of them, as will have been seen, being so in a very marked degree. It has been, of course, impossible to mention the whole of the noxious species, nor is it necessary to do so, as many are so similar in their habits that one may be accepted as a type of the whole. All the most destructive, however, have been described, and the same plan will be adopted in dealing with insects belonging to other orders.

CHAPTER IX.

EARWIGS AND MOLE-CRICKETS.

The Earwig and its life-history—Its fondness for flowers—The earwig as an unappreciated insect—A popular superstition—Object of the tail-forceps—Analogy of the earwig with "cocktail" beetles—How the wings are folded—The forceps as a means of defence—Maternal solicitude of the earwig for her young—An earwig colony—"Earwig" or "Ear-wing"?—The Little Earwig and its abundance—The Mole-cricket—Why so called—Strength of the digging limbs—Cylindrical form of the body—Life-history of the mole-cricket—Omnivorous character—Insect cannibals—An unnatural mother—The mole-cricket upon the Continent—*Thrips* and their structure—Their mischievous habits—The Corn-thrips and its ravages—Early life of the insect—Thrips in the greenhouse.

So universally familiar an insect as the common Earwig (*Forficula auricularia*) requires no description, and we may therefore proceed at once to the history of its life.

Injurious it undoubtedly is, more especially in flower-gardens, seeming by some special instinct to select the choicest blossoms, and to destroy them by feeding upon the petals. Nor are floriculturists the only sufferers from its ravages, for the farmer often finds that the young shoots of his growing crops afford very evident signs that earwigs have been at work upon them.

Notwithstanding its destructive character, however, it cannot be denied that the earwig has been greatly misunderstood, and even unappreciated, for it is one of the many insects which, although noxious in some respects, in others as certainly beneficial. It has long been known, for instance, that the earwig varies its diet by an occasional meal upon the far more injurious aphides and thrips, and only lately it has been detected in the act of feeding upon the *cocci*, or scale-insects, which are often such terrible garden pests.

Again, the earwig is even yet considered by perhaps the majority of mankind to be a creature specially designed and intended for the torment and annoyance of the human race. It is supposed, with fiendish persistency, to be ever on the watch for an opportunity of creeping into the human ear, in order that, unhindered by anatomical obstacles, it may thence make its way to the brain, which it so affects by its presence as to cause madness in the sufferer. And, moreover, the pincers with which the tail is furnished can, it is assumed, have but one object, and that the nipping of human flesh.

The absurdity of the first belief is so self-evident that disproof is unnecessary; and that of the second may be shown by pointing out that scarcely one earwig in ten thousand ever meets with a human being, so that it is scarcely logical to suppose that special organs should have been provided for use only upon such very exceptional occasions. The true object of the tail-forceps is of a very different

character, and may be explained by a glance at the peculiar structure of the wings.

These, as is the case with the beetles popularly known as "cocktails," are far larger than the elytra which cover them when not in use, and must consequently be neatly folded in order that they may be reduced to similar dimensions. But how is the insect to bring this about? The wings themselves are furnished with no muscles which could cause their contraction, and it would therefore seem that when once spread they could not again be packed away beneath their tiny cases. But the operation, thanks to the forceps, is very simply conducted. The wings are first shaken loosely into folds by a peculiar jerking movement; next, the flexible abdomen is bent backwards in the direction of the head; and, finally, the elytra are raised by the pincers, and the wings neatly folded and placed beneath them. The wing-cases are then replaced and gently smoothed down, and the business is completed, having occupied from first to last but two or three seconds of time.

Earwig.
(*Forficula auricularia*).

The delicacy with which the pincers are used throughout the operation is really wonderful, and could not be surpassed by a skilful human operator furnished with the most perfect of microscopic forceps. None but

those who have ever attempted the task of replacing an extended earwig's wing beneath its covering can appreciate the true difficulty of the task which the insect performs so easily.

Considered as weapons of offence and defence, there is no doubt that the earwig makes use of the forceps when menaced by any danger, and can administer a tolerably smart pinch to the fingers of its captor. But this is only natural under the circumstances, and the muscular power of the organs in question is, after all, so slight that no real injury is inflicted.

Whether viewed in the light of a friend or in that of a foe, the earwig certainly deserves our respect for a certain trait in its personal character, and that the more remarkable inasmuch as, so far as is known, it is exhibited by no other insect. This lies in its care for its eggs and young, which, contrary to the usual custom of insects, are watched over and protected by the mother, who will even surrender her life in defence of her offspring. This is more than can be said even for the bee itself, whose young are watched over and tended, not by the queen-bee, or mother, but by her delegates, while she does not personally concern herself in any way with regard to her offspring.

It is not at all uncommon in early spring to find the maternal earwig sitting over her eggs; not, of course, with the intention of hatching them by her own bodily warmth, but in order to defend them from the many enemies which would otherwise destroy them. A

little later on she may be found mounting guard over the living young in similar fashion. I have several times met with four or five such colonies in the course of a single morning.

Larva of Earwig.

The grubs of the earwig are wonderfully like small editions of the perfect insect, excepting that the wings are wanting, and that the forceps are soft and only partially developed. In the pupa, which leads an active life, the first rudiments of wings show themselves, to assume in the perfect insect a structure of singular beauty, which is of so unique a character as to have led to the separation of the earwigs from the division to which they were formerly considered to belong, and the formation of a special order for their reception.

Pupa of Earwig.

The general form of these organs, when fully extended, is very much that of the human ear, which has led many to suppose that the name "earwig" is merely a corruption of "ear-wing." Their chief peculiarity lies in the wonderfully intricate character of the system of nervures which supply the necessary rigidity, and in the number of hinges, if we may use the expression, which allow the wing to be folded into so small a compass. On account of this structure, the order to which the earwigs belong is termed *Euplexoptera*, a word signifying "beautifully-folded wings."

The common earwig, being a lover of darkness,

is very seldom seen while in the act of flight, preferring to remain concealed in some gloomy corner until the shades of night have set in. An almost equally plentiful species, however, viz., the Little Ear-

Mole-cricket
(*Gryllotalpa vulgaris*).

wig (*Labia minor*), may sometimes be seen peopling the air in numbers, preferring the cool hour before sunset for its aërial evolutions.

NEXT we come to that singular insect the Mole-cricket (*Gryllotalpa vulgaris*), which, but for its com-

parative scarcity, would probably be found as great a pest in this country as it is in many parts of the Continent. Even as it is, some of our crops occasionally suffer considerable damage owing to its root-feeding proclivities, and in localities where it is at all plentiful it certainly deserves to be ranked as a very injurious species.

Few insects possess more felicitous titles than the mole-cricket, which bears a really wonderful resemblance to the animal from which it takes its name. The fore limbs, in particular, are almost exactly similar to those of its mammalian prototype, both in their astonishing muscular power and in the arrangement of the large and broad claws with which the lower part of the leg is furnished. In proportion, of course, to the size of their owner, too, these limbs are gifted with at least an equal power of driving long tunnels through the soil. The foot itself is small and insignificant, not used in digging, and so formed that it can be tucked away beneath the *tibia*, or lower part of the leg, in order that it may sustain no injury during the process of tunnelling. The form of the body is cylindrical, as in all burrowing creatures, in order that the least possible resistance may be afforded in its passage through the ground.

Leg of Mole-cricket (Magnified).

Mr. Curtis has so well described the life-history of this insect that I quote his own words :—

"In June, or at the commencement of summer, the female constructs in the vicinity of her burrows a nest half a foot deep in the earth; it is two inches long and one deep, formed like an oval bottle, with a curved neck which communicates with the surface. The inside surface is smoothed for the reception of the eggs, which amount to 300 or 400, and after they are deposited the female accurately closes the entrance. These eggs are about the size of turnip-seeds, but oval, shining, and brownish-yellow. The young hatch in July and August, or about a month after the eggs are laid. They immediately begin to feed upon the tender roots of the surrounding plants, whether corn, grass, or vegetables; and, when these fail, then they go further in search of food; but subsequently to their first moult, which takes place a month after they emerge from the egg, the family disperses.

"When the mole-crickets first hatch, they look very much like black ants, and are not more than one-eighth of an inch long; at this period they have no wings. They go on growing and moulting until they are one inch and a half long, when rudiments of the wing-cases appear, and in this pupa state they remain feeding and increasing in bulk until the fifth or last skin is cast off, and the perfect winged insect is developed, and fit to propagate the species. This metamorphosis takes place at the close of spring; they live through the summer, pairing and laying eggs, and pass the winter in the earth, burying themselves deeper as the frost and cold affect them. There

protected they remain from October or November until the warm days of March again invite them to the surface, when they may be traced by the heaps of earth they throw up like little mole-hills; at other periods their presence may be detected by their operations, for yellow withered patches deface the pastures, and similar decay is indicated among the garden vegetables."

Notwithstanding the nature of the damage wrought by the mole-cricket, the insect is by no means a strict vegetarian in its diet, for it is not at all averse to a meal of raw meat, should it be at any time able to obtain such a dainty. Occasionally, also, it evinces cannibalistic propensities, and, after engaging in battle with one of its own kind, regales upon the body of its vanquished foe, while a well-known authority states that the female insect generally devours nine-tenths of her own young.

During the day-time the mole-cricket seldom emerges from its burrow, preferring to wait until darkness has fairly set in before emerging into the outer world. Some observers have stated that it is a luminous species, and has in many cases been taken for the "will-o'-the-wisp." This assertion, however, does not appear to have been satisfactorily proved.

In this country we have had but little experience of the mischievous capabilities of the mole-cricket, for it is a local insect, and seldom sufficiently abundant to cause any great or widespread damage. In some parts of the Continent, however, hundreds of

thousands of the insect are annually destroyed by traps and poisons of various kinds, while probably a far greater number fall victims to various insectivorous mammals and birds. Perhaps the most ingenious method of destruction is that proposed by Köllar, who suggested that several moderately deep pits, two or three feet in diameter, should be sunk in infested lands towards the end of September, filled with fresh horse-dung, and then covered in with earth. As soon as the first sharp frost sets in the insects would be attracted in numbers by the warmth of these pits, and might then be killed in great quantities at the expense of but little trouble.

Belonging to the same order as the mole-cricket, we have the well-known Migratory Locust, which has more than once been captured in Great Britain. It is evident enough, however, that all such specimens are accidental visitors, and, as it is neither an indigenous nor a naturalised species in this country, it can find no place in these pages.

CONSTITUTING in themselves a separate order, the curious little insects known as Thrips merit more than a mere word of passing mention.

These mischievous little beings must be tolerably familiar to almost every resident in the country, for they have an annoying habit of settling upon the face and hands, flying into the eyes, &c., whenever the sun is warm enough to tempt them forth from their retreats. In gardens, greenhouses, corn-fields, &c., they are almost always in profusion, and in some

years cause considerable damage by their attacks upon certain crops.

Scientifically these insects are known as *Thysanoptera*, a word signifying "tassel-winged," on account of the peculiar structure of the organs of flight. These, which are present only in the female insect, are long and straight, and deeply fringed with hairs of such length that in several cases the border is wider than the wing itself. The upper wings are not modified into elytra, as is the case with the beetles, the earwig, and the mole-cricket, but, with the lower pair, lie flat upon the upper surface of the body while not in use, the tips slightly crossing one another. The size of the wings varies very much in different species, some possessing the merest rudiments only, and being consequently quite devoid of the power of flight.

Thrips cerealium (Magnified).

Perhaps the most destructive member of the group is that infesting corn (*Thrips cerealium*), which sometimes appears in such numbers as to destroy nearly a fourth part of the crop. In some parts of the Continent it is even more plentiful than in England, and is looked upon as one of the most injurious of insects. Like most of the corn-feeders, it is especially mischievous to late and backward crops, being unable to carry on its ravages after

the plants have begun to harden and turn colour at the approach of maturity. Its attack is always made upon the ear, the insect driving its beak into the furrow of the grain and keeping up a continual drain upon the juices, in very much the same manner as has been already described in the case of the aphis. In spite of its small size, the entire body being barely one-twelfth of an inch in length, the damage thus caused by the corn-thrips is sometimes very considerable, a great part of almost every ear being rendered perfectly unfit for use.

While still in the earlier stages of their development, the thrips are fully as injurious as the perfect insect, all three forms, grub, pupa, and imago, being often found feeding together. Very little change in appearance takes place as the insect approaches maturity, a small hump upon the thorax of the female pupa, however, denoting the presence of rudimentary wings, and the colour altering from yellow to black.

Larva of Thrips (Magnified).

In green-houses, the thrips are in the habit of congregating in numbers upon the plants, always taking up their position upon the lower surfaces of the leaves, which they cause to wither and even to die by the continual abstraction of their juices. In the fruit-garden, too, they are very injurious to peaches, plums, apricots,

&c., creeping into the ripe fruit at the base of the stalk, and then penetrating into the soft parts surrounding the stone. Were they but gifted with the wonderfully reproductive power of the aphides, indeed, there can be little doubt that they would be fully as injurious.

CHAPTER X.

SAW-FLIES.

The turnip and its various foes—Their extreme voracity—The Turnip Saw-fly—Its enormous numbers—Characteristics of saw-flies—Origin of popular title—The saws and their office—"Tenon" saws an invention of Nature—How a saw-fly lays her eggs—The grubs and their numerous legs—How to distinguish the turnip saw-fly—The caterpillar, or "nigger"—Its terribly destructive character—Does the egg grow?—Curious attitude of the grub—The pupæ and their cocoons—Emergence of the fly—Harmlessness of the perfect insect—Influence of wet upon its development—Fastidious appetite of the insect—The Gooseberry Saw-fly—Appearance of the perfect insect—Life-history—Beauty of the grub—Its mischievous proceedings—How to destroy the grub—The Rose Saw-fly—Its singular larva—The Pine Saw-fly and its habits—Method of feeding—Abundance upon the Continent—A dissertation upon poison—Slug-worms and their parentage—Their distasteful flavour—Life-history—Slug-worms in Canada.

THERE is, perhaps, no cultivated plant which is infested by more numerous or more destructive foes than the turnip in its different forms, and it is truly wonderful, considering the numbers and the activity of these, that a crop of this vegetable should ever arrive at maturity. From the moment in which the seed is placed in the soil to that in which the adult plant is pulled from the ground, the turnip is literally beset with foes, any one of which, when at all

numerous, is sufficiently powerful to strip the fields of their entire produce, and, even in seasons of less abundance, to cause the loss of many thousands of pounds by the character and extent of its ravages. And these foes are the more injurious, inasmuch as, so far as we at present are aware, they cannot be put to any useful purpose which might in some degree compensate for their depredations.

There is certainly none of these insects more terribly injurious than the well-known Turnip Saw-fly, or "Nigger" (*Athalia spinarum*), which is represented with its larvæ in the accompanying illustration, and a magnified figure of which is also given on page 135. Year after year we read of losses caused by its agency, while in some seasons its numbers are so enormous that human exertions can no longer cope with it, the insect becoming for a time the practical master of the situation.

This only too abundant pest is one of the Saw-flies, a group of the Hymenoptera (*i.e.*, the order comprising the bees, wasps, ants, &c.), whose principal characteristics may be thus briefly summed up.

In the first place, all four wings are membranous, the upper pair being invariably larger than the lower, while the nervures which supply the necessary strength and rigidity are so dispersed as to form a number of "complete" cells, or those closed in upon every side. In the next, the abdomen is not connected with the body by a narrow footstalk, as in the wasps and ichneumon-flies. And, thirdly, the extremity of

the body in the female is armed with the singular apparatus from which the members of the group derive their popular title.

This apparatus consists of two flat, horny plates, set

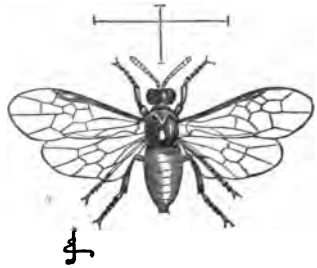
Turnip Saw-fly and Larvæ.

side by side upon the lower surface of the last segment of the body, which are freely movable at the will of the insect, and each of which has a number of sharp teeth set upon one edge, while the other is strengthened exactly after the manner of our own "tenon" saws.

Had the structures of those tools, in fact, been avowedly borrowed from the saws of the insect, the resemblance could not have been more complete. The teeth themselves are of very complicated character, each being cut into a series of grooves, which are separated from one another by an exceedingly sharp edge, a structure evidently intended to prevent the weapons from becoming clogged by the moist bark, &c., through which they have to pass. Each saw works in a kind of sheath, into which the strengthened back is received, and the muscular system connected with them is so arranged that, while one is drawn back, the other is thrust forward, an alternate sawing motion being thus constantly maintained.

By means of these saws the female insect cuts grooves, varying very much in size and depth, in the twigs or leaves of the plant which is to serve as food for her future young, and in each of these grooves places one or more eggs, the number varying according to the species. The ovipositor through which the eggs are conducted to the position assigned to them is a soft organ, which transmits at the same time a small drop of fluid, by which they are fastened firmly into their places. In due course of time the eggs hatch, and produce grubs not unlike the caterpillars of certain moths, excepting that the ten claspers, or "false feet," with which the lower surface of the body is normally furnished in those insects, are in the saw-fly grubs reinforced by from one to three additional pairs, the total number of these organs being thus from twelve to sixteen.

These, of course, are the characteristics of saw-flies in general. The turnip saw-fly, with which we are now more immediately concerned, may be known from most of its fellows by the orange colour of the body, which extends over all parts, with the exception of the head, and the sides and base of the thorax. The grub is of a peculiar greyish-black colour, which has earned for it the popular title of "Nigger."



Turnip Saw-fly
(*Athalia spinarum*).

The rapidity with which these grubs perform their destructive work is perfectly astonishing. The eggs hatch, and the turnips disappear as though by magic, the leaves being entirely eaten away, with the exception of the stronger ribs, through which the jaws of the insects cannot penetrate. As Mr. Newman graphically puts it, in describing a visitation of the insect:—"Since my last visit, they" (the turnips) "had been swept from the face of the earth. The land was everywhere as bare as on the day it had been sowed. There was no speck of green for the eye to rest on. It was a wild and universal desolation; and the black, crawling vermin that had caused the ruin were clustered in bunches on the ground, or lingering about the skeletons of the turnip-leaves.

No plague of Egypt could have been more effective; the mischief was complete. Some fields received the blast a few days later than others, but all had it; not one escaped, unless the crop were Swedes, and it is remarkable that these were untouched."

According to the same careful observer, the egg itself receives nutriment from the juices of the turnip-leaf in which it is deposited, and benefits so greatly thereby as to increase to three times its size before the grub makes its appearance. This takes place, as a rule, upon the ninth day from that upon which the egg was laid, the young grub immediately beginning to feed with the greatest voracity, and eating away the leaf from the edge towards the centre. When the insect is at all numerous, fifteen or twenty of these grubs may be seen upon every leaf, their tails raised in the air in the curious attitude which they always assume, and stripping every vestige of green from the plants with the most astounding rapidity. If they are alarmed or disturbed, they have a curious habit of coiling their bodies into a ring, and retaining their hold merely by the first pair of legs, so that the slightest touch causes them to fall to the ground, where they remain until they suppose the danger to have passed away.

It is rather a singular fact that, before the first change of skin, which takes place some six or seven days after their birth, the grubs are able to spin a silken thread, after the fashion of many caterpillars, by which, if alarmed, they can let themselves down from their food-plant to the ground, and re-ascend

when they consider themselves once more in safety. After casting their first skin, however, this power passes from them, and they are then obliged to depend for purposes of locomotion upon their legs and claspers alone.

If the weather be tolerably fine and warm, these grubs complete their growth in rather less than three weeks from the day upon which they left the egg-shells, and then proceed to bury themselves in the soil in order to assume the pupal form. Before doing so, however, they construct for themselves small oval cocoons, composed of particles of earth firmly cemented together by a tenacious fluid secreted for that purpose, which are impervious to wet, and also set at defiance the powerful jaws of the various predacious insects.

The period of time passed in the pupal condition is very variable and uncertain. If the season be hot and dry, the grubs throw off their larval skins in the course of ten days or so, and appear as perfect insects about a week later. More commonly, however, the greater proportion remain unchanged in their cocoons throughout the autumn and winter, pass into the pupal condition in the following May, and emerge in their perfect state early in July, or a little later, if the season be a backward one.

This, however, is merely a general rule, for in some seasons we hear of the flies making their appearance in the month of March, and of three successive broods being noticed in the course of the summer. All, of course, depends upon the weather. In a hot and dry year the development will be accelerated, and

vice versâ, just as is the case with all insects with whose life-histories we have as yet been able to make ourselves acquainted.

Unlike many destructive insects, the turnip saw-fly is quite harmless in its perfect state, the whole of the mischief being brought about by the extreme voracity of the larva. In a wet season the insect seldom causes any great amount of mischief, excessive moisture seeming to affect the grubs severely, and generally causing their death in a very short time. An infested crop should always, if possible, be heavily watered as soon as the presence of the insect is discovered; and if ducks can be procured in large quantities and driven into the fields they will clear the plants almost as if by magic. So invaluable are they, indeed, that "Rusticus" declares his firm belief that the only possible way of saving an infested crop is by their agency.

No precise rules, strangely enough, can be laid down with regard to the manner in which the attack takes place. Sometimes Swedish turnips will be passed over altogether, while the English variety is totally destroyed; upon other occasions the exact reverse is the case. Sometimes one side of a field only is infested, the grubs steadily proceeding onwards until the whole is laid waste; or perhaps a small patch of ground will be passed by, although the adjacent plants upon all sides have been entirely stripped of their leaves. More than once the central portion of a field has been black with the grubs, while the borders were perfectly untouched. And for all these

peculiarities we can assign no reason, although it is tolerably certain that some cause which would fully account for them must exist, although we have as yet been unable to discover it. One or two grubs alone might possibly pass over certain plants from mere whim or caprice, but it is scarcely credible that the myriads inhabiting the field should all be actuated by similar fanciful dislike. It is far more probable that the reason lies in the condition of the plants themselves, some peculiarity affecting a portion of the crop, and rendering the leaves distasteful to the grubs which would otherwise destroy them.

ANOTHER very destructive saw-fly is that attached to the common gooseberry, which is accordingly known as the Gooseberry Saw-fly (*Nematus grossulariæ*). There are but few gardeners who have not had some practical experience of this insect, which, pretty though it is, in some years is so exceedingly abundant as to become a source of widespread injury, stripping the gooseberry and currant bushes of their foliage, and so entirely destroying their crop of fruit.

This saw-fly is not at all a large insect, the head and body scarcely exceeding a quarter of an inch in length, and the spread of the wings being little more than two-thirds of an inch. The head and thorax are yellowish, with rather variable black markings, while the abdomen and legs are of a deeper and almost orange colour, the antennæ, the feet, and part of the tibiæ of the hinder legs being blackish. The anterior margin of the fore-wing is also ornamented

with a black streak, the extremity of which is dilated into a triangular spot.

The female insect makes her appearance almost as soon as the buds of the gooseberry show signs of bursting, and deposits her eggs in small grooves, which she cuts in the strong veins of the under surface of the leaves. These eggs are generally very numerous, not less than sixty or seventy having in many cases been placed upon a single leaf. In a very short time the grubs emerge from the eggs, and at once begin operations upon the leaf on which they find themselves, piercing it with holes until but little of its substance is left remaining. By degrees they spread over the entire bush, and, in bad attacks, leave nothing of the foliage save the stalks and the harder veins, which their tiny jaws are unable to penetrate.

These grubs themselves have some little pretensions to beauty. The ground-colour of their bodies is a bluish-green, each segment being spotted with black, and the head, the feet, and the tail being also black. Immediately behind the head is a small patch of yellow, a second similar patch being found close to the tail; these contrast strongly with the hue of the remainder of the body, and add considerably to the appearance of the insect.

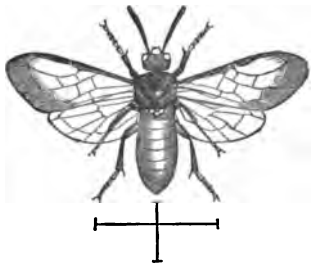
The general life-history of the gooseberry saw-fly is not at all unlike that of the species infesting the turnip, the weather affecting the development of each in a similar manner, and determining the length of the period over which the introductory stages of ex-

istence extend. The grubs, too, bury themselves in the earth at the approach of winter, just as do those of the turnip saw-fly, and there spin for themselves cocoons, in which they lie unchanged until the warmer days of spring come round. The pupal condition is then assumed, and the perfect insect makes its appearance in the course of three or four weeks.

Even when they attack currant-bushes these grubs are troublesome enough, and generally contrive to perform a considerable amount of mischief before they can be completely exterminated. But, in the case of the gooseberry, matters are far worse, owing to the thorns with which the branches and twigs are so liberally furnished, and which render "hand-picking"—by far the most satisfactory plan of dealing with such pests—a matter of no little difficulty. After the damage is done, the insects can be destroyed without much trouble, by removing a few inches of earth from beneath the bushes and treating it freely with lime; and this, of course, will much decrease the chances of attack in the following season. While the grubs are still feeding, however, it is very difficult to cope with them, and but few of the applications which have from time to time been recommended seem to meet with more than very partial success.

A THIRD species, the Rose Saw-fly (*Hylotoma rosæ*), is, as both its popular and scientific names imply, one of the insects which find their food in the common rose, and is greatly obnoxious to gardeners on account of the damage which it sometimes causes

to the cultivated varieties of that plant. The larva is a very singular one, the sides of each of the abdominal segments being produced into a kind of flap, which conceals from view the claspers, or "false legs," with which that part of the body is provided. Like the grub of the turnip saw-fly, it has a way of raising the tail into the air while engaged in feeding. The perfect insect is represented in the accompanying illustration.



Rose Saw-fly
(*Hylotoma rosæ*).

ALTHOUGH it is by no means a plentiful insect in Great Britain, we must not pass by the Pine Saw-fly (*Lophyrus pini*) without mention, for upon the Continent it is one of the most destructive members of the group to which it belongs, and has even been known to cause considerable damage in our own country.

As its name implies, this saw-fly feeds, while in the larval state, upon the pine, the grubs attacking the needle-like leaves, and eating them rapidly away as far as the stems. When these are devoured, the young shoots are stripped of their bark, and as the larvæ are in the habit of living in large companies, each member of which is the owner of a literally insatiable appetite, it may well be imagined that their

proceedings are by no means of a beneficial character. The havoc which they cause, moreover, is the greater in that the pine, unlike trees in general, cannot recover when stripped of its foliage, and so sustains far more damage than the immediate injury would seem to warrant.

In this country we suffer but little, comparatively speaking, from the depredations of this insect, whose scarcity limits its mischievous powers. In the large pine-growing districts of the Continent, however, it is a terribly destructive creature, and, but for the predacious *Calosoma* beetle, which finds in the saw-fly grubs a favourite dainty, would, in a very few years, bring about the absolute ruin of large tracts of forest.

The pine saw-fly is one of the many insects the two sexes of which are so totally unlike each other that they might well be taken as belonging to separate species. The male is entirely black, unrelieved by brighter colour, and with deeply-feathered antennæ; those organs in the female, however, are almost simple, while the body is yellow, with a black or grey-black band crossing the abdomen, the head being also black. There is also considerable disparity in point of size between the two, the male being far smaller than his spouse.

Pine Saw-fly (*Lophyrus pini*) (Magnified).

It is rather a singular fact that the turpentine, which is so freely exuded from the pine-shoots, should have no injurious effect upon the grubs which are continually devouring it. Yet such is the case, and, after all, we have far more remarkable instances of a similar character in the insects which feed and thrive upon such plants as the deadly nightshade, the hemlock, and the tobacco-plant, whose poisonous properties seem to influence certain animals only, and to have no deleterious influence whatever upon others. The word "poison," of course, is merely a relative term, and the fact that the juices of a certain plant are fatal when introduced into our own systems is no reason at all for supposing that they must be equally so in the case of other and differently constituted beings.

THE unsightly and mischievous creatures popularly known as "Slug-worms," which are sometimes so plentiful upon the leaves of the pear, the plum, and the cherry, are the larvæ of a saw-fly belonging to the genus *Selandria*, and are remarkable for the greenish-black and glutinous liquid which is exuded by them in such quantities as to envelop the whole of the body. It is to this slimy fluid that they owe their title of "slug-worms," a name of American origin, and one which is wonderfully expressive of the appearance of the insects.

Although these grubs may be seen resting by day in a fully-exposed position upon the upper surfaces of the leaves, they are nocturnal in their habits, and remain motionless throughout the hours of daylight.

Partly owing to this fact, and partly, probably, to their singular appearance, which is more that of inanimate lumps of slimy jelly than of living beings, the various insectivorous birds seem to pass them by, so that their numbers are not kept down as are those of injurious species in general.

These grubs feed in a somewhat curious manner, eating away the whole of the upper surface and the soft matter of the leaves, but leaving the veins and the skin of the lower surface entirely untouched. The eggs are laid in July, and the larvæ appear in the course of the following month, their growth being completed soon after the end of September. Their shape is very singular, the body being flat, the legs very short, and the thorax broadly dilated, giving the insect somewhat the appearance of a bolster, the feathers of which have been principally concentrated into one extremity, to the consequent detriment of the remainder.

At the final moult, a most extraordinary alteration takes place in the appearance of the grubs, their dark, blackish-green hues giving place to a yellow or buff colour, and the slimy covering totally disappearing. A few days after this change the larvæ descend to the ground, bury themselves in the soil, and there spin for themselves silken cocoons, after the fashion of those of their relatives which have before been described. In Canada, where it is only too plentiful, this fly first appears in spring, a second brood following six or eight weeks later on, so that the insect is far more destructive than in our own country.

CHAPTER XI.

INJURIOUS BUTTERFLIES.

The *Lepidoptera* and their characteristics — Food, and its influence in the world—Food in relation to structure—The trunk, or proboscis, of a butterfly—Harmlessness of perfect insects—The Cabbage-butterfly—Life-history—The eggs, and how they are laid—Their wonderful beauty—The caterpillars, and their first meal—The chrysalis—Foes of the cabbage-butterfly—Value of their work—Increasing scarcity of the butterfly — The Small White — Its life-history—The eggs, and their sculptured surface—Appearance of the caterpillars—Their down-covered bodies—The chrysalis and its variable colouring—Different food-plants of the caterpillar — The small white as a migrant—Its first appearance in Canada—The Green-veined White—Naturalists at variance—How to distinguish the green-veined white.

TURNING to the large and important order of the *Lepidoptera*, or Butterflies and Moths, we find that many injurious species are included in this well-known group, some of them taking high place in the ranks of the noxious insects. Before proceeding to discuss the individual species, however, a few remarks may not be out of place upon a peculiarity in the bodily structure of the Lepidoptera, which separates them in a very important particular from all those insects with which we have had hitherto to deal.

It may be said with truth that Food is the main-

spring of the animal world. No matter in what particular manner the influence of any living being is exerted upon ourselves or upon the world at large, that influence is due, either directly or indirectly, to the character of its food. Every animal, whether great or small, whether highly or lowly organised, inherits two great instincts: the first, and most important, that of self-preservation, and the second, that of providing for a future generation. To these paramount necessities all else is subservient; by them the entire progress of animated nature, from the lower forms to the higher, has been directed; and in them we may find a key to many of the apparent mysteries which confront the investigator in every branch of his researches.

In the former of these instincts is implied, of course, that greatest of all necessities, the provision of a constant and adequate supply of food. Without nourishment there can be no growth; without growth, no maturity. And whether that food be obtained from the animal or the vegetable kingdom, its acquisition must necessarily be the main object in the life-history of every created being.

Even man himself is not exempt from this law. His civilisation, it is true, renders it unnecessary for each individual to depend for his sustenance entirely upon his own exertions in agriculture or in the chase, but he is nevertheless bound by the same far-reaching rule, although its influence upon him is of a less restricted character than in beings beneath him in point of intellect.

From this law a second must logically follow, namely, that the particular influence of any animal is due to the special manner in which its food is obtained. The burying-beetles and their allies purify the earth, *because* they feed upon decaying animal matter; the ichneumon-flies and other parasites assist the growth of vegetation, *because* they prey upon certain insects which are destructive to various crops; the wood-destroying insects perform a similar duty, although in a different manner, by converting dead and useless trees into what is practically manure, and at the same time clearing the ground from that which is no longer of service. And so also in other branches of the animal kingdom.

And in the case of the butterflies and moths, this law permits them to destroy our crops while in their larval condition, but prevents them from injuring us as perfect insects. The active work of a butterfly or a moth is completed as soon as it throws off its larval skin, and enters upon the chrysalis stage of its existence, its sole duty in its perfect condition being to provide for a future generation, and, this task fulfilled, to die. Such nutriment as it requires at this period of its life is of a liquid character alone, and consists of the juices of the various flowers which happen to be in bloom while it is upon the wing.

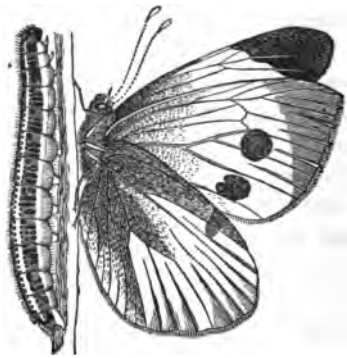
Structure being in all cases dependent upon habit, the jaws and the various parts of the mouth are consequently modified into a long and flexible trunk, or proboscis, which can be extended to its extreme length when required for service, or coiled away

beneath the head while not actually in use. By means of this trunk the honey can be extracted from the flowers and sucked into the mouth, the insects thus being able to provide themselves with a meal which, but for the possession of such an organ, they could by no possibility obtain.

Section of Proboscis of Butterfly.

The food of the winged insect being entirely of a liquid character, we may take it as an axiom that no butterfly or moth is injurious to us, excepting while in the caterpillar stage of its existence. Its larvæ may bring about damage to the extent of many hundreds of thousands of pounds, but the perfect insects cannot cause to us the loss of a single penny, their mischievous powers having ceased at the moment when they assumed their pupal form, and left them in the condition of perfectly neutral beings. In spite of the popular belief to the contrary, for instance, the clothes-moth itself is perfectly harmless to our woollen goods, such injuries as it causes in our houses being entirely due to the ravages of its caterpillar. We may therefore fairly consider that, mischievous though many lepidopterous insects may be during their caterpillar life, they nevertheless scarcely deserve to take so high a place in the ranks of injurious species as those whose destructive work is carried on throughout

their entire existence, and which are equally noxious as larvæ, as pupæ, and as perfect insects. Fortunate indeed is it for us that this is the case, for were certain of our butterflies and moths enabled to continue their mischievous proceedings from the moment of leaving the egg-shell until that in which they paid the debt of Nature, we should possess in them foes whose importance could scarcely be over-estimated,



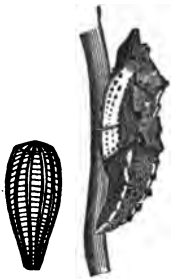
Large White Butterfly (*Pieris brassicæ*) and Larva.

and should find that the hindrances to the cultivation of certain crops were so great that we should seldom or never be able to bring them to maturity. Even as it is, the influence of many species upon our interests is injurious enough, as may perhaps be in part seen by a perusal of the following pages.

First upon the list comes the common Large White, or Cabbage-butterfly (*Pieris brassicæ*), an insect too familiar to require description.

The life-history of the cabbage-butterfly is of a very interesting character, and may be briefly summed up as follows:—

The eggs are laid by the female insect upon the lower surface of the leaves of the common cabbage, and are generally placed in small batches of from four to eight or ten in number. In form, as Mr. Newman well remarks, they are not unlike champagne-bottles which have had the upper part of the necks knocked off, and stand at right angles to the leaf, to which the basal portion is firmly attached by means of a glutinous fluid secreted by the insect for that special purpose.



Egg and Pupa of Large White Butterfly.

Small as these eggs are, they are nevertheless most wonderfully beautiful objects when placed beneath the microscope, their exquisite sculpturing putting to shame the most elaborate productions of human art and skill. From base to apex run a series of eighteen or twenty bold ribs, crossed transversely by a still larger number of transverse ridges, entirely surrounding the egg, which are chiselled with the most delicate care. A kind of raised pattern is thus formed, which gives to the egg a singularly elegant appearance, and renders it an object well worthy of the closest examination.

The young caterpillars, on making their appearance in the world, commence operations by devouring the

egg-shells from which they have just emerged, and then transfer their attentions to the leaf upon which they are resting. Until their second change of skin they remain in small companies, rapidly gaining in size, and devouring a wonderful quantity of food in a very short space of time. As soon as their increasing appetites render more solitary habits desirable, they separate and spread to all parts of the plant, but little of which remains untouched by the time that their development is completed.

As a general rule, the caterpillars remain in their larval condition for about a month, and may at once be known by the three yellow stripes which run from end to end of the body, contrasting strongly with the bluish-green ground-colour, into which, nevertheless, they melt almost imperceptibly. One of these stripes is situated upon the dorsal line of the body, and the remaining pair upon the sides, these being slightly broader than the former. Upon all the segments of the body are a number of small black tubercles, each of which emits a single whitish hair, and which are sometimes surrounded by small blotches of the same sombre hue; the legs and the lower surface are dull yellowish-green.

When full fed, these caterpillars betake themselves to some convenient spot, such as a fence or wall, the eaves of an out-house, &c., where they may find partial shelter from the inclemencies of the weather, and there affix themselves firmly, not only by several strong silken threads attached to the tail, but also by a belt of similar character surrounding the body.

The larval skin is then thrown off and reveals the chrysalis, which is an angular object of a bluish-white colour, liberally sprinkled with blackish dots, and with a narrow yellow line running along the back. The insect is double-brooded, appearing in May and again in August, the former generation having passed the winter in the pupal state.

Full-fed Caterpillar of Cabbage White Butterfly (*Pieris brassicæ*).

Were it not for the untiring activity of a certain small ichneumon-fly, whose grubs feed within the body of the cabbage-caterpillar, it is doubtful whether we should ever be able to bring a crop of that vegetable to maturity, so great is the voracity of the insect, and so prolific its character. But the parasite performs its duties most thoroughly, scarcely one caterpillar in ten escaping its vigilance, and even the favoured few, when they have safely passed through the larval stage of their existence and assumed the chrysalis form, being yet liable to the attacks of a second insect of similar character; so that, luckily for ourselves, the numbers of the butterfly are never allowed to increase beyond their due limits.

Of late years it would seem that these two little

flies have proved more useful than ever before, the cabbage-butterfly having become almost a scarce insect in certain parts of the country. In the course of the last five seasons I do not think that I have seen more than twenty or thirty living specimens of the insect, while ten years ago it was one of our most abundant species throughout the spring and summer months. And, moreover, upon those occasions on which large swarms of the butterflies have crossed the Channel and arrived upon our shores, their natural enemies have coped with them so effectually that their descendants, usually in the first generation, were almost totally destroyed. Even when the caterpillar is unusually plentiful, it is often quite difficult to find a specimen which has been passed over by its deadly little foe.

Another of the cabbage-butterflies, namely, the Small White (*Pieris rapæ*), is almost equally injurious, and is now far commoner than its larger relative. At least four out of every five white butterflies which we see in the course of the year belong to this species, which is continuously on the wing from April to October, and which is certainly by far the most plentiful of all our British butterflies.

The eggs of the small white are not at all unlike those of the species already described, the longitudinal ridges, however, not exceeding twelve in number. They are not deposited in clusters, but are placed singly, and always upon the upper surface of the leaf, on which, in spite of their small size, they form fairly conspicuous objects. In the course of from ten days

to a fortnight, according to the condition of the temperature, the caterpillars emerge, and make their first meal upon the shells which lately enclosed them, just as do those of the preceding species.

The young caterpillars are not particularly handsome creatures, the ground-colour being a dull green, almost exactly similar to that of the leaves upon which they are resting. The body is semi-transparent, and three small white tubercles are situated upon either side of the central segments. The hairs with which the body is sprinkled are very curious in form, resembling small and exceedingly delicate pins with tiny spherical heads, the points of which have been inserted into the body.

After the second moult, a considerable change takes place. The ground-colour is still of a dull green, but it is now diversified by a pale-yellow streak which runs along the back, and also by a few spots of the same hue which are placed in pairs upon the sides. Upon each segment are five transverse wrinkles, and both head and body are covered with small wart-like excrescences, each of which emits a single hair. So densely are these hairs sprinkled over the surface of the body that, except when closely inspected, the insect appears to be clothed with a coating of short and delicate down.

The chrysalis varies very greatly in colour, the general hue being a kind of pale greyish-yellow, spotted with very small black markings. Some specimens, however, are green, others brown, and some even almost red, all these different shades being

commonly found in members of the same brood, so that no definite rule can be given.

There are always two broods of the small white butterfly in the course of the year, the first appearing in April and the second in August. The descendants of the latter of these pass the winter in the pupal condition, just as is the case with the preceding species.

Neither the large nor the small white entirely confines its attacks to the cabbage, although that plant is certainly the most highly favoured by both insects. Turnips are sometimes infested by the caterpillars, and radishes and white mustard are also occasional food-plants, although these are seldom attacked, except in districts in which the cabbage is little cultivated.

The small white is an occasional migrant, vast swarms sometimes crossing the sea and making their unwelcome appearance upon our coasts. Such a visitation took place in the year 1846, when myriads of these butterflies arrived at Dover, after making the transit of the Channel, and rapidly spread themselves inland. More singular still, in 1863, the insect arrived in great numbers in Canada, where it had previously been unknown, and there took up its abode, as we are told in an interesting paper published in the *Zoologist* for 1864, in which this extraordinary instance of migration is discussed at some length. How the insects should have crossed so wide an expanse of ocean it is difficult to tell. It would seem impossible that they should travel day after day with

neither rest nor food, and yet it is equally impossible that either should have been obtained during their journey. How, then, did the butterflies support the fatigue of their pilgrimage, and how dispense with nourishment for so long a period of time?

As regards the influence of the Green-veined White Butterfly (*Pieris napi*) upon agriculture, there seems to be a considerable difference of opinion. Mr. Curtis tells us that it is certainly an injurious species, and states that in the year 1841 it was especially destructive, eating into the hearts of the cabbages and lettuces, and so causing the death of the plants. Upon the other hand, Mr. E. Newman, writing several years later, emphatically denies that the insect attacks any of our cultivated crops, and states his firm belief that, to use his own words, "the accounts of its destructive powers are entirely fabulous." As the butterfly in its earlier stages is very similar to the preceding insect, it is not at all unlikely that in many cases the two species have been confounded with each other, and the one thus blamed for damage caused by the other alone; and yet it is hardly possible that so careful an observer as Mr. Curtis should thus have been mistaken. Were he correct, however, it is singular that his assertions are unsupported by further evidence, and that we should have met with no second instance of the destructive powers of the insect from that day to this.

From its relatives the green-veined white may be readily distinguished by the fact that the under

surface of the hinder wings is marked with several greenish-black veins upon a yellow ground, which are often noticeable even when the insect is flying, and are very distinct and almost conspicuous when it is at rest. It is a tolerably plentiful insect, and in some districts is almost as abundant as the small white itself.

CHAPTER XII.

INJURIOUS MOTHS.

Destructive moths—The Lackey-moth—Beauty of the caterpillars—How the eggs are laid—Web spun by the young larvæ—The cocoons—Appearance of the perfect insect—The Magpie-moth, and its abundance—Its variable colouring—Life-history—Beauty of the larvæ—"Loopers," and their singular method of walking—Hibernation of the larvæ—An aërial cradle—Magpie-caterpillars and insectivorous birds—The pupa, and its cocoon—The magpie-moth in 1879—The Winter-moth—Time of appearance—Its sober colouring—The wingless female—The eggs, and their gradual change of colour—The larvæ, and their manifold food-plants—Their self-made homes—How to destroy the perfect insects—The Antler-moth—Its ravages in grass lands—Abundance in 1824 and 1881—The antler-moth in the Harz country—The larvæ and their dingy appearance—Curious habit of perfect insect—The Cabbage-moth—Its destructive character—The caterpillar and pupa—The Turnip-moth—Life-history—The larvæ and their ravages—The Yellow Underwing—Why so called—The caterpillar and its destructive habits—The Codlin-moth—Its wonderful beauty—Singular life-history—The pupa and its resting-place—The Small Ermine—Its larvæ, and their social habits—Destructive character—The small ermine in the orchard—The Green Oak-moth—Leaf-rolling caterpillars—The Clothes'-moth.

So large is the number of moths which are more or less injurious, that even the mere mention of many of these is impossible, and we must therefore select

Eggs, Larva, and perfect Male and Female of Lackey-moth (*Bombyx neustria*).

the most destructive only, and consider them as in great measure types of the remainder.

DURING spring and early summer, apple-trees are often infested by the caterpillars of the Lackey-moth (*Bombyx neustria*), which cause considerable damage by devouring the foliage. They are pretty creatures, of a bluish-grey ground-colour, with a white streak running along the centre of the back, and three orange-red stripes upon either side of the body, which is thickly clothed with long hairs.

The eggs from which these caterpillars proceed are laid by the parent moth in a wonderfully neat ring round the twigs of the apple-tree, where they may be found in quantities during the autumn and winter. Upon first emerging, the caterpillars are gregarious, and spin a large silken web, which serves them as a retreat while not engaged in feeding, and which is gradually enlarged until its inmates separate, and take upon themselves the responsibilities of independent existence. Sometimes as many as two hundred caterpillars may be found congregated together in one of these webs, which, owing to their large size, form very conspicuous objects upon the branches of the trees.

When full fed, the caterpillars spin for themselves oblong yellowish cocoons, in the fabric of which a curious sulphur-like powder is somewhat abundantly mixed, and therein change to pupæ, from which the perfect insects emerge in the month of July. The moth itself is rather a handsome insect, the wings

being either dark yellow or rich-brownish red in hue, and the anterior pair being traversed by two paler bars, which run rather obliquely from the front to the hind margin. The body is stoutly built, the thorax clothed with long hairs, and the antennæ are slightly feathered. As is the case with most of the lepidoptera, the female is decidedly larger than her mate.

Owing to its social disposition, the lackey-caterpillar is easily destroyed while young, and the appearance of its webs upon the trees need cause no uneasiness. If its extermination is delayed, however, it is apt to do considerable mischief, its appetite being enormous, and the foliage disappearing with astonishing rapidity.

THE very variable insect known as the Magpie-moth (*Abraxas grossulariata*) is generally plentiful in gardens, where it feeds upon the gooseberry and the currants, and sometimes occurs in such numbers as to strip the bushes of their leaves.

This is a most difficult insect to describe, for it is so inconstant in its markings that a dozen or more specimens may be consecutively taken, none of which shall exactly resemble any of the remainder. The ground-colour is white, with a yellow blotch at the base of the fore-wings, and an angular transverse band of the same colour rather beyond the centre. A great part of the remainder of the wings is occupied by a number of large black spots, varying greatly in size and shape in different specimens, and often running into one another to so great an extent as to

give the insect the appearance of belonging to a totally distinct species. In some examples, again, the black markings are almost wholly absent, while the pattern of the wings upon the right-hand side of the body is occasionally quite different from that exhibited by those upon the left. More remarkable still, the wings of one side are in some abnormal specimens nearly half as large again as those opposite to them, so that the moth may fairly be considered as one of the most variable insects of which we have at present any knowledge. The fact that, at a recent sale by auction, a single series of different varieties of this moth was sold for the sum of £105, speaks for itself.

The eggs are laid singly upon the leaves, and shortly produce caterpillars which, as far as colour is concerned, are wonderfully like their parents, the ground-colour of the body being a creamy white, an orange stripe running along the sides, and a number of black spots being scattered over the back. These caterpillars are "loopers," or, in other words, belong to that large group whose feet are placed at the extremities of the body only, so that the back is drawn up at every step into a kind of arch or loop.

After feeding for three or four weeks, the caterpillars are warned by the approach of winter that they must desist from their meal, and then proceed to form for themselves retreats in which they may lie until the warm days of spring awaken them once more to active existence. This they do by spinning together the edges of a leaf, after having fastened it

securely to the twig from which it depends by a number of strong silken threads, and thus form a pensile cradle, in which they rest secure throughout the wintry cold and storms. As soon as the first leaves make their appearance in the following season, the little tenants leave their self-constructed domiciles, and resume their interrupted feast, which they continue without cessation until the time comes for them to enter upon the next stage of their development.

The pupa is enveloped in a slight and even flimsy

"Looper" Caterpillars.

cocoon, of a perfectly transparent character, which is generally either affixed to a twig or placed in some convenient crevice. The moth appears upon the wing about midsummer, and is universally abundant. In the abnormal season of 1879 it was in such profusion in certain localities as to outnumber almost every other insect. From the hedge which borders the road leading from Greenhithe railway station to Darenth Wood I must have knocked out upon one occasion at least a thousand specimens.

For some reason or other, the caterpillar of the

magpie-moth seems to be distasteful to toads, insectivorous birds, &c., which refuse to devour it, and leave it entirely unmolested. Why this should be we cannot tell with any degree of certainty, and can only suppose that it possesses some peculiarly nauseous flavour, which secures it from being selected by way of a meal.

PLENTIFUL and destructive as is the Magpie-moth, however, it sinks into comparative insignificance before the still more abundant Winter-moth (*Cheimatobia brumata*), which, as its name implies, makes its appearance at a time when insect life in general is conspicuous by its absence. This is the moth which we see so commonly fluttering round the gas-lamps upon any mild evening in December or January, in its vain attempts to discover the secret of the mysterious flame within, and which may also be commonly found as it rests motionless upon palings and tree-trunks during the day-time. As a general rule, the insect is on the wing at intervals from the middle of November until the end of February.

Winter-moth
(*Cheimatobia brumata*).

The winter-moth is by no means a handsome insect, its hues being confined to the more sombre shades of grey and brown, as befits the season of the year at which it appears. Across the fore-wings run

several indistinct wavy bars, which in some specimens can hardly be traced, while the hinder pair, which are slightly paler in hue, are almost entirely without markings of any kind.

This description, however, applies to the male insect alone, for the winter-moth is one of those singular beings of which one sex only seems to require the power of flight, the wings of the female being so small as to be perfectly incapable of raising their owner into the air. Shortly after sunset these practically apterous females may be found ascending the trunks of trees, &c., in order to deposit their eggs, their long legs giving to them a very spider-like appearance as they run rapidly over the bark.

Female Winter-moth (*Cheimatobia brumata*) (Magnified).

The eggs of the winter-moth are deposited in the crevices of the bark, &c., and are of a pale greenish-white hue when first laid. As the formation of the caterpillars within them progresses, however, they gradually change colour, first to orange, and finally to brown, the larvæ appearing early in the month of April.

These larvæ are by no means of a fastidious disposition, as regards the character of their diet, for there is scarcely a tree upon the leaves of which they will refuse to feed. They are especially injurious, however, to such cultivated fruits as the plum, the

medlar, the apple, and the pear, almost stripping the trees of their leaves, and consequently damaging or even wholly destroying the crop of fruit. Upon first leaving the egg-shells, they burrow into the, as yet, unexpanded buds, feeding therein until the leaves burst forth as the season progresses. As soon as the buds have fully opened, they spin two or three leaves together with silken threads, so as to form a retreat in which they may be partially secure from the attacks of their numerous foes. These domiciles they seldom leave, remaining partially therein even when engaged in feeding, so that they may be able to withdraw themselves from observation at the first sign of danger. If the trees are violently shaken, however, they seem to consider that concealment is no longer possible, and seek safety by lowering themselves upon silken cables to the ground, to re-ascend in a similar manner when they suppose themselves once more in security. Owing to this habit, they can be destroyed without any great difficulty, all that is necessary being first to shake the boughs, and then to collect the caterpillars before they return to their retreats.

"Looper" Caterpillar suspended by thread.

Like the larvæ of the magpie-moth, these caterpillars are "loopers," and are very long and slender creatures, of a green or brown hue, with a narrow black stripe running along the centre of the back. Upon either side of the body are three longitudinal white streaks, generally more or less indistinct, while a fourth is sometimes found bordering the dorsal stripe, and consequently rendering it unusually conspicuous. Towards the middle or end of May the caterpillars leave the trees and bury themselves in the ground, in order to assume the pupal form, from which the perfect insects emerge during the following winter.

The most effective method of destroying the winter-moth seems to consist in painting a narrow ring of Stockholm tar and cart-grease, mixed in equal proportions, round the stems of the trees as soon as the moths appear. By this plan the female insects will be caught as they ascend the trunks in order to deposit their eggs, and many hundreds, or even thousands, may thus be killed without trouble. As soon as it dries, the application must be renewed, and continued until the moths have finally disappeared, taking care that no low bushes surround the trees by means of which the insects can ascend. In the following spring the bark must be slit, as the composition is apt to unduly tighten it.

Our next example of injurious moths shall be the Antler (*Charæas graminis*), which has of late years been very destructive to grass lands in certain parts

of the country. This is one of the *Noctuæ*, or Owl-moths, so called from their custom of flying only during the hours of darkness, and hiding themselves away in dark corners as soon as the unwelcome daylight appears. To this rule, however, there are many exceptions, of which the present insect is an example.

The antler moth is not a very large insect, the spread of wings being as nearly as possible one inch and a half. It is somewhat stoutly built, however, like most members of the group to which it belongs, and so appears larger than many species which are really superior to it in point of size. The fore-wings are of a reddish brown, with two pale spots near the centre, and three white streaks running longitudinally along the principal nervures, while a broad zigzag band of light brown lies parallel with the outer margin. The hind-wings are of an almost uniform greyish brown, and are without markings.

Even so long ago as the year 1741 the ravages of the antler caterpillars were recorded from Sweden, the destruction of the grass crops being almost universal. Thirty-seven years later the attack was repeated on a scale of equal magnitude, and from that time to the present we have accounts of the appearance of the insect at irregular intervals in different parts of the Continent and of our own country, sometimes in such numbers as to cause a terrible amount of damage. Thus a correspondent of the *Entomological Magazine* for 1832 remarks:—"Some years ago (in 1824, I believe), during the spring and early

summer the herbage of a large portion of the level part of Skiddaw . . . . comprising at least fifty acres . . . . was observed, even from the town of Keswick, to assume a dry and parched appearance; and so marked was the line that the progress made by the larvæ down the mountain could be distinctly noted."

In 1881, the insect was again very plentiful, and elicited many attempts to account for its sudden appearance and its great abundance. In an editorial note in the *Entomologist's Monthly Magazine* for July of that year, we are told that—"Great commotion prevails in Clitheroe, and the district surrounding the famous Pendle Hill, a distance of about three miles, in consequence of the arrival of a large quantity of caterpillars which occupy the land from Wiswell to Mearley, near Pendle Hill, a distance of about three miles. They travel together in thousands at a good speed, and devastate the land over which they pass to an alarming extent. The inmates of a roadside inn are kept continually at work brushing them out of the house. The road is almost black with the larvæ, whose advent is considered mysterious, numbers of people continually going to view them, and numbers of larvæ being exhibited in shop-windows. The caterpillars seem also to be abundant on some of the adjoining moors. We have seen specimens, and find that they are the larvæ of *Charæas graminis*, the well-known 'Antler' moth, which was very abundant last year in Tatton Park, Knutsford. Their ravages in Sweden and our own Lake district have often been recorded."

In the Harz country, in 1816, and again in 1817, some of the hills which were fresh and green overnight were stripped bare before morning, so abundant were the caterpillars and so voracious their appetites. It is also recorded that at the same time the roads were dirty, and even slippery, owing to the numbers of crushed larvæ with which they were strewn.

These caterpillars are very unattractive-looking objects, the body being of an almost uniform dirty-brown colour, with the exception of three longitudinal stripes of pale yellow, one of which runs along the centre of the back, while the remaining pair are placed upon the sides. The greater part of its existence is passed beneath the ground, where it feeds upon the roots of the grass. The perfect insect appears towards the end of August.

The moth itself has one great peculiarity, namely, that it flies almost entirely between half-past seven and half-past eight o'clock in the morning, a time when very few lepidoptera are to be found upon the wing. A well-known entomologist of the earlier part of the present century has graphically described his first meeting with the insect, and his astonishment at the sudden appearance of the moth in great numbers as he was taking an early stroll, and the equally sudden conclusion of its gambols. Every specimen seems to be simultaneously actuated by the same impulse, a host of moths appearing and vanishing very much as a flock of birds alter their course in the air, the will of the individual being entirely merged in that of the main body. Mr. Curtis, how-

ever, remarks that he has frequently noticed the moth upon the wing towards the hour of sunset.

Destructive though the antler-moth undoubtedly is, it is fortunately a very local species, and in many parts of England is never met with. Such is not the case with the far more mischievous Cabbage-moth (*Mamestra brassicæ*), however, which is universally abundant, and which deservedly bears a character fully as bad as that of the Large White Butterfly itself.

This is not at all a handsome insect, the fore-wings being dark blackish-brown, with a variety of indistinct markings, and relieved only by a tolerably large whitish spot towards the centre; the hind-wings are of an almost uniform grey-brown, with the nervures outlined in black. The moth is a fairly large species, being about one inch and three-quarters in spread of wing, and stoutly built even in proportion to its size.

As with all lepidoptera, of course, this moth is injurious only during its caterpillar life, at which period of its existence it feeds upon the different varieties of the cabbage, eating its way into the very heart of the plant, and filling its tunnels with a watery and evil-smelling fluid, and with pellets of refuse matter. Nor does it confine its attacks to cabbages alone, for there is hardly a garden-plant with which it is not almost equally satisfied, and which consequently is not more or less a sufferer from its ravages.

Then, again, unlike many insects, it feeds both by day and by night, so that its ravages are literally con-

tinuous, until it throws off the larval skin and assumes the pupal form. And so deeply does it penetrate into the plants that it can scarcely be extracted even when its presence is discovered, which is not always the case even when the cabbages are prepared for table. Many a dish of summer cabbage is flavoured with one or more of these caterpillars, which often escape the eyes of the most vigilant of cooks, and, happily, of those also for whose benefit the vegetables are intended.

The ill-looks of the perfect moth are shared by the larva, which is a dingy and insignificant-looking creature, the upper part of the body being a dull olive-brown, and the lower surface a dirty yellow. On each segment is a rather darker triangular mark, bordered by a lighter shade, in the centre of which are two small white spots, placed side by side; upon either side of the body, also, runs a slight chain of similar spots. These colours are subject to some little variation, however, very few specimens being exactly alike in every respect. The pupa is of a glossy reddish-brown colour, and lies buried in the earth throughout the winter, the moth making its appearance on the wing from May to July.

HOLDING high rank among the multitudinous foes to whose depredations the turnip is exposed is the only too abundant Turnip-moth (*Agrotis segetum*), which in some seasons is productive of immense damage to the plant after which it is named. There are few moths, indeed, of more injurious character than this

insect, which, owing to the peculiarity of its habits, is beyond our reach while its destructive operations are being carried on, and so prosecutes its ravages in comparative safety from the various means of prevention which might otherwise be adopted.

The caterpillars of the turnip-moth, which are of an almost uniform smoky-brown colour, feed while yet young upon the leaves of the turnip and other plants, and have a curious habit of gnawing away the stem exactly at the spot at which it enters the ground. In the course of a week or two, however, they change the character of their diet, burrowing into the ground and entering the roots, which they thenceforth leave only when their food-supply runs short. Eaten away by rapid and ever-increasing degrees, the roots soon cease to supply the leaves with the requisite nourishment, and the plant droops, withers, and finally dies, the destroyer being meanwhile concealed from view, and consequently safe from almost any attack which can be made upon it.

It is rather a singular fact that a small proportion of these caterpillars assume the pupal form early in October, while the remainder defer the operation until the following spring. The former of these emerge in the course of a few days, and seem in no case to deposit eggs, leaving to their less rapidly-developed relatives the task of propagating the species.

The moth itself is about an inch and a half in spread of wing, and is rather a handsome insect, the fore-wings being greyish brown, with a variety of confused markings, while the hinder are of a delicate

pearly white, clouded with brown towards the hind margin in the case of the female.

THE common Yellow Underwing (*Triphæna pronuba*) is also one of our most destructive moths, the caterpillar feeding on almost every cultivated plant, and seeming particularly attached to the lettuce. The moth is a very handsome one, and may be at once known by its large size, and by the bright orange hue of the hind-wings; the anterior pair are very variable in colour. It is an exceedingly plentiful species, and is wonderfully fond of concealing itself during the daytime in strawberry-beds, from which it may often be turned out by dozens. The flight is very peculiar, swift, and curiously erratic, and seldom seems to be continued for more than a few seconds. The insect, indeed, reminds one very much of the giant Antæus of mythological renown, whose strength left him unless he were in constant contact with his mother, the Earth, for it really seems unable to fly for any distance without repeatedly settling upon the ground, as though to recuperate its energies.

The caterpillar of the yellow underwing is a very bulky and clumsy creature, varying in colour from green to brown, and concealing itself by day beneath the surface of the ground. It is full-fed early in spring, the moth appearing on the wing in June and July.

ONE of the most mischievous of the smaller lepidoptera is the well-known Codlin-moth (*Carpocapsa*

pomonana), which is responsible for the numerous "worm-eaten" apples which annually fall from our trees before attaining to maturity. This is a singularly pretty insect when viewed by a suitable light, the fore-wings being of a rich brownish hue, banded at base and apex with a darker tint, and adorned by an oval spot of brilliant gold, which is placed in the outer margin near the posterior angle. The centre of this golden spot is of a deep brownish-red, appearing almost black in certain lights. Several slight streaks cross the wing transversely, imparting to it a curiously damask-like appearance, while the whole of the upper surface has a peculiar lustre, which must be seen to be appreciated. The hinder wings are blackish. For the group to which it belongs, it is a tolerably large species, the spread of wings being about three-quarters of an inch.

The eggs of this moth are laid singly in the fruit of the apple while yet scarcely formed, the caterpillar tunnelling obliquely downwards, and so avoiding the core. In the course of a fortnight or so it has eaten its way almost to the centre of the apple, and then, finding that its passage is becoming choked by the rapid accumulation of frass, continues the burrow until the rind is perforated, and a second outlet secured. This part of its task satisfactorily achieved, it returns to the centre, and continues to feed until nearly full-grown, when a sudden desire for change of diet takes possession of it. For the remainder of its larval existence, accordingly, it abjures the softer part of the fruit, and, penetrating to the core

feeds upon the pips alone. After a few days the damaged apple, weakened by its loss of substance, falls to the ground, whereupon its destroyer leaves its burrow, ascends the trunk of the tree, and selects some convenient crevice in the bark which may serve as a habitation during the next stage of its development. Both the fall of the apple and the escape of the caterpillar seem usually to take place by night, so that the destruction of the mischievous little creatures is not at all easy.

Having duly concealed itself in some suitable cranny, the caterpillar next proceeds to enlarge its temporary dwelling, gnawing away the wood until it has constructed a neat little oval chamber of sufficient size to accommodate it in comfort. Next it spins a silken cocoon, by way of a further protection from its numerous foes, and finally, after the lapse of three or four weeks, throws off the larval skin and assumes the pupal form, wherein it remains throughout the months of winter and early spring. As soon as the apple-blossoms fall and the young fruit begins to form, the moth emerges, and sets to work to provide for the wants of a future generation.

Although by no means fastidious in its tastes, the codlin-moth certainly gives the preference to the particular variety of the apple from which it takes its name, and in some seasons is so plentiful as to occasion the loss of a considerable proportion of the crop of fruit.

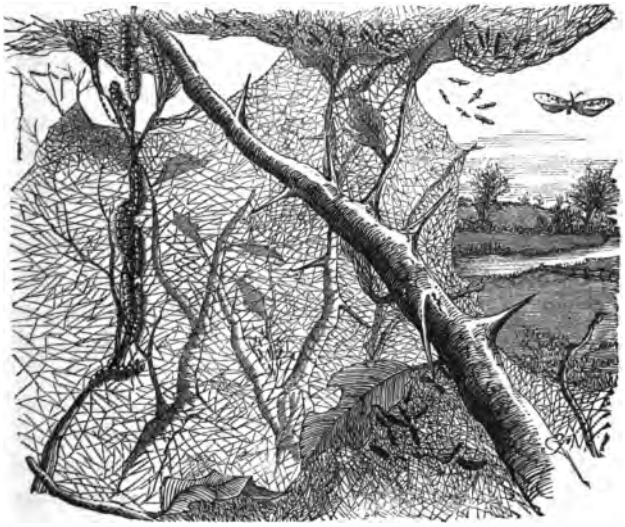
ANOTHER destructive member of the *Micro-lepidoptera*,

those minute beings the study of which makes such terrible demands upon the patience of the entomologist, is the Small Ermine Moth (*Hyponomeuta padella*), which, notwithstanding the simplicity of its colouring, is really one of the prettiest members of the entire group. And this on account, not of the brilliancy of its colouring (for the hues are confined merely to black, white, and various shades of grey), but of the beautiful satiny sheen of the fore-wings, which preserve their glossy purity even in the dingiest suburbs of the Metropolis, in spite of the smoke and soot with which the air is filled.

Sprinkled irregularly over the fore-wings are a number of small black spots, contrasting wonderfully well with the pearly-white ground-colour, which also gains considerably in effect, owing to the dull leaden hue of the hinder pair. The insect is by no means a large one, even though the extended wings measure nearly three-quarters of an inch from tip to tip, and yet is a veritable giant in comparison with many of its nearest relatives,

The caterpillars of the small ermine moth are of a social disposition, and live in large companies in whitethorn hedges, which are often stripped of their foliage by the constant attacks of the voracious little creatures. By way, probably, of a protection from their enemies, these caterpillars spin a common web, enclosing a number of leaves, and enlarge it as often as their food-supply becomes exhausted. For some little time after their birth they content themselves with the pulpy portion of the leaf lying between the

upper and under surfaces, but, after a few days have increased their size and strength, they leave their burrows and devour the entire substance of the leaves, after the fashion of caterpillars in general. When full-fed, each caterpillar suspends himself head down-



Caterpillars of Small Ermine Moth
(*Hyponomeuta padella*).

wards from a portion of the web and becomes a pupa, the perfect moth emerging about midsummer.

The caterpillars are sometimes so extremely abundant that the whitethorn hedges are almost entirely covered by their webs, while scarcely a single leaf escapes destruction by their tireless jaws. Owing to

their curious mode of life, they cannot well be mistaken for any other species, and the insect is so widely spread and so universally abundant that it must be more or less familiar to almost all.

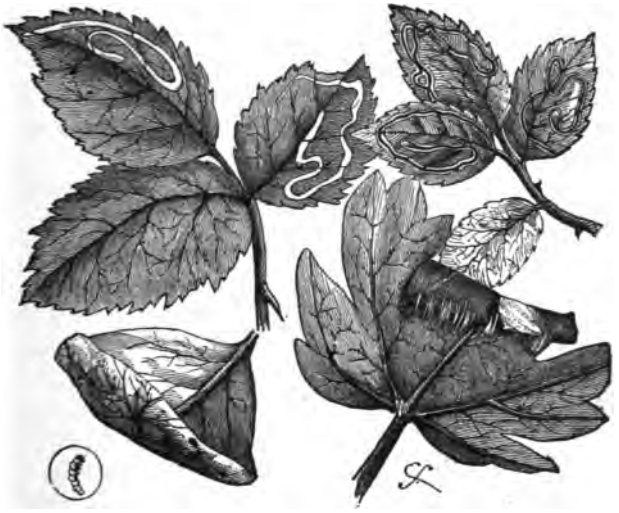
A variety of the insect, which in some of our lists is ranked as a separate species under the title of *H. malivorella*, is equally destructive in apple-orchards, which suffer as greatly from its attacks as do the whitethorn-hedges from those of the typical form. Owing to the conspicuous character of the webs, however, and its habit of feeding in large companies, it is a tolerably easy insect to destroy, and ought never to be the cause of any great damage. It is necessary, however, that no time should be lost in attacking it when once the webs appear, for each day will add to the mischief caused, and that, of course, in an ever-increasing degree.

PASSING by many other almost equally mischievous species, we must devote a few lines to the consideration of the exceedingly abundant and destructive Green Oak-moth (*Tortrix viridana*), that pretty little creature with pea-green upper wings which is so universally plentiful in early summer.

This is one of the many small moths whose caterpillars bear the title of "Leaf-rollers," owing to their curious habit of curling the leaves upon which they are feeding into cylinders, and fastening them firmly into position by means of a number of silken threads. In these coiled leaves they make their retreats, and therein enter upon their pupal existence

when their caterpillar life is concluded. If alarmed in any way, however, they leave their little domiciles, and suspend themselves in mid air by means of a silken cable, which they ascend again when the threatened danger has passed away.

In certain years these caterpillars are very injurious



Leaf-rollers and Miners.

to oak-trees, which they almost entirely strip of their leaves. Excepting in these occasional seasons, however, the moth is scarcely plentiful enough to cause any great amount of damage, its small size, moreover, greatly circumscribing its destructive powers.

It may be thought, perhaps, that a description of the

Clothes'-moth would be almost necessary in a work of the present character. I have purposely omitted the insect, however, not only owing to the limited character of its ravages, but also on account of its otherwise beneficial character in the world. For, were it not to devour the hair and wool with which the fabric of the nests of birds is consolidated, and which atmospheric influences are unable to destroy, our trees would in course of time be so loaded by the annual accession of new material as to be damaged and even killed by the overloading of the branches, and their consequent inability to give forth foliage. In our houses, of course, the insect is decidedly injurious, and must be ruthlessly exterminated whenever it makes its appearance. But, after all, human habitations do not form its natural abode, and, as it is undoubtedly beneficial when not in actual contact with man, it is scarcely fair to consider it as an injurious insect. Like the common gnat, it is partly friend and partly foe, and seems, if its life-history be duly considered, to have greater claims to the former than to the latter title. I shall not, therefore, now consider it, feeling that it does not merit a position among insects which, in the present state of our knowledge, are, in almost every case, of an exclusively noxious character.

CHAPTER XIII.

SCALE-INSECTS, BISHOP'S MITRES, ETC.

Scale-insects, or *Cocci* — Their extraordinary life-history — Degeneration of the female—Comparative beauty of the sexes in insects — The life-history of the *coccus* — The Mussel-scale—Its destructive habits—Exotic *cocci*—Bishop's Mitres—Their doubly injurious character—Offensive odour —An unpleasant experience—Bishop's Mitres in Assam—*Phytocoris tiliæ*—Beauty of the perfect insect—Fragility of the *Phytocoris*—Its activity—The Bed-bug—Its foreign origin — Total absence of wings — Number of broods —How the eggs are laid—Natural food of the Bed-bug—Its relatives and their parasitic habits—The common Flea—The *Aphaniptera*—Why so called—Leaping powers of the flea—Strength of the hinder limbs—The flea beneath the microscope—Life-history of the flea—Beak of the perfect insect—Concluding remarks.

NEXT to the *Aphides*, which have already been described, the singular little creatures known as Scale-insects (*Cocci*) are probably the most injurious members of the order *Homoptera*, which comprises the various species of Frog-hopper, or "Cuckoo-spit," and many other well-known insects. In some parts of the country these scale-insects are also termed Mealy-bugs, on account of the white substance in which the young are enveloped.

As regards the character of their life-history, these little beings stand absolutely alone among insects, the

females becoming, as Mr. Westwood justly remarks, more *imperfect* as they approach the perfect state. Paradoxical as this statement may appear, it is nevertheless strictly true, for the female larva, when newly emerged from the egg, is in all respects save one more highly organised than the parent from which she originated. She cannot as yet lay eggs, and so provide for a future generation, but in every other particular she is certainly superior to the adult female, which, indeed, by none excepting experienced eyes, would be recognised as an insect at all.

We have already met with a somewhat similar instance of disparity between the sexes in the case of the Winter-moth, the female of which, it will be recollected, is furnished with rudimentary wings only, and is, consequently, incapable of taking to flight. And this moth is only a type of many others in which the one sex is winged and the other apterous, the males being in all cases the favoured ones, and possessing the power denied to their less fortunate mates.

This rule appears also to operate in another direction, viz., as regards the comparative beauty of the two sexes. Throughout the animal world, in almost every instance in which the males differ to any great extent from the females, the former are by far the more handsome or the more attractive in other ways. It is the lion, and not the lioness, which is furnished with the heavy mane which imparts such a grandeur to his appearance. It is the male nightingale which delights our ears with its floods of melody; the male

bird-of-paradise whose resplendent plumage we so greatly admire; the male Blue Butterfly which exhibits the glorious metallic hue from which it derives its name. And so also in many other cases, beauty, when not common to both sexes alike, being invariably a characteristic of the male animal.

There are few more striking examples of this rule than that afforded us by the scale-insect, the male of which is a winged and active little being, while his mate is as unattractive a creature as can possibly be conceived, looking more like an inanimate swelling of the bark than a living insect, and being absolutely incapable of locomotion of any kind. It is somewhat strange, indeed, from our point of view, that she should exercise any influence over the male, which is far superior to her in every way; and it would seem little more singular that a humming-bird should be fascinated by a tortoise than that the masculine scale-insect should entertain any regard for his unwieldy mate. Fortunately for himself, however, the zealous little swain does not see with our eyes, and doubtless considers his bulky spouse as the very incarnation of grace and beauty—a view of the matter which could certainly be entertained by none excepting himself.

When they first emerge from the egg-shells, both male and female larvæ are very similar in appearance, being active, six-footed little creatures, with two long bristles projecting from the extremity of the body. In the course of a short time they fix their beaks, which are not unlike the corresponding organ of the

aphis, into either the bark of a branch or twig, or the stronger veins of a leaf, and then proceed to extract the sap, which serves them for food and drink alike. Once having taken up their position they move no more, the females for the remainder of their lifetime, the males until they assume their perfect form.

This they do in the succeeding spring, and then appear as pretty and graceful little flies, varying in colour according to the individual species, and of dimensions far inferior to those of their stationary mates. The females are of the size and shape of an ordinary pea, without the slightest trace of articulation in either body or limbs, and, as before remarked, are entirely without the power of shifting their position.

After a brief existence the male dies, and his widow, who survives him for some little time, at once commences the important business of depositing her eggs, which are enveloped in a kind of whitish down, and are placed beneath her own body, sometimes to the number of as many as two thousand. As her task draws near its close her body gradually collapses; hardens; withers; and the insect is dead, her lifeless form still covering and protecting the family born at the cost of her own existence, and concealing them from the view of their foes until they commence the business of life for themselves.

One of these scale-insects—*Aspidiotus conchiformis*—is very plentiful upon apple-trees, and, owing to the shape of the shell, if we may so term it, which covers the eggs, is popularly known as the Mussel-scale.

It is more particularly abundant upon the soft bark of the trunk and branches, and sometimes causes great damage by the constant drain upon the sap. Another species, of much smaller size, is equally abundant upon the pear, while many other cultivated trees and plants are infested in a less degree. Even in greenhouses the insects are sometimes very troublesome, attacking the leaves and stems of the choicest plants, and often causing an immense amount of damage before they are discovered.

As if to make amends for the unpleasant qualities of their relatives, however, some of the exotic *Cocci* furnish us with substances of great commercial value, and find place among the very few insects which are *directly* serviceable to mankind. Thus an Asiatic species produces the well-known "lac," which is so valuable in many ways, and another, inhabiting South America, furnishes us with the brilliant dye known as cochineal. It may well be, therefore, that in course of time we shall find that our British scale-insects may be put to some useful purpose, and thus compensate in greater or less measure for their ravages upon vegetation.

NEXT upon our list we have several insects belonging to the order *Heteroptera*, in which the basal part of the wings, when those organs are present, is hard and leathery, while the remainder is membranous and semi-transparent. This order includes the only too familiar Bed-bug, the Water-boatman, and many other well-known insects.

A large number of the *Heteroptera* are classed together under the popular title of Bishop's Mitres, a name derived from the peculiar form of their bodies, which is certainly suggestive of the episcopal head-dress. These are injurious in two totally distinct ways, the one by feeding upon the sap of various cultivated plants, and the other by the evil-smelling liquid which they exude from the hinder feet, and which so taints the fruit, &c., over which they have passed as to render it totally unfit for human consumption.

No one who has ever incautiously swallowed a raspberry which has been visited by one of these insects is ever likely to forget his experience. The odour and the flavour are so indescribably nauseous, and the latter clings to the palate so pertinaciously, that some hours at least must elapse before the immediate effects pass away, no matter how often the mouth may be rinsed, while in the case of the larger species the effects will be of a yet more lasting character. I was upon one occasion unfortunate enough to swallow, not merely a tainted berry, but the visitor itself as well, which had clung so closely to the fruit as to escape my observation. Luckily it belonged to one of the smaller species, but, nevertheless, my feelings were such as I shall never forget; had I taken a teaspoonful of the strongest cayenne pepper the pain could hardly have been more severe. My throat was so contracted that I could scarcely breathe; my mouth seemed to be filled with liquid fire, and for several minutes I could only stand and gasp, almost choking from the effects of the poisonous fluid, and unable

to speak or even to see. By slow degrees these unpleasant symptoms passed away, but not for the whole of that day did I lose the disgusting flavour of the insect, in spite of all the measures which I took to rid myself of it.

Unpleasant as the bishop's mitres are in our own country, however, they would seem to be insignificant when compared with those inhabiting tropical lands, whose disagreeable qualities appear to be multiplied at least a hundredfold. A recent traveller, Mr. Charles H. Lepper, has most amusingly described his experiences of these insects in Assam, in a short account of his adventures in that part of the world.

"The worst of all," he says, "are the scented insects. They have a less polite name out here. There are a variety of these, too; some most innocent-looking, like pretty little light green grasshoppers, others very like the Norfolk Howards in Europe. Once come within range of the perfume of one of these gentry, innocent-looking or not, and you will never forget the circumstance. You *taste* him several yards off, for the perfume has a greasy, oily kind of consistency, which clings to the palate as well as to the nasal organs, and causes a hysterical swelling in the throat and epigastric region calculated to beat all apothecaries' emetics out of competition. If one gets hidden in your soup, or in your vegetables, and you touch any of the soup or any of the vegetables that have been in his neighbourhood, you can retire for a convenient interval, and begin dinner all over again from the beginning when you get back, what

you took before counting for less than nothing. If you touch one with your fingers by accident, it takes a cake of brown Windsor soap and three fills of a 6 ft. 6 in. bath to wash the perfume off.

"I have heard Englishmen say that, once having tasted soup tainted by one of these, you can distinctly call up that taste seven years afterwards, and if you dwell a little on it the effects will be just the same as when you actually went through your first experience. For my own part, I can quite believe it, and if they had told me that this flavour, once tasted, went down in families from one generation to the next, I should not have felt justified in questioning the veracity of that statement without having proofs on my side to refute it."

A CONSIDERABLE number of *Heteroptera* inhabit this country, several of which are destructive to fruit, while others perform a beneficial service by feeding largely upon aphides, alike in their larval, pupal, and perfect stages of development. One of the former class, known as *Phytocoris tiliæ*, is very mischievous among raspberry-bushes, sucking the juices of the fruit, and tainting the berries which it attacks to so great a degree as to render them perfectly uneatable.

This is a remarkably pretty insect, of a pale greenish-grey hue, with a narrow border of a darker colour, and with various patches of grey down sprinkled upon the upper wings. Upon examination with the microscope, these grey markings are seen to be composed of a mixture of black and white hairs in tolerably

equal proportions. The legs are yellow, spotted, and banded with black, the markings, however, both of legs and of wings, varying considerably in different specimens.

Phytocoris tiliæ.

A curious point about this species is its extreme fragility. The attachments of the legs and antennæ seem to be of the slightest possible description, and, common though the insect is, it is by no means easy to obtain an absolutely perfect specimen. When caught and killed, too, it is almost certain to sustain more or less damage during the operation of mounting, even under the hands of a skilful operator, so that a really uninjured example is very rarely seen.

This insect is very fond of sunning itself upon fences and walls in the summer and early autumn, running with great rapidity, and taking to flight at the slightest alarm. I have caught many specimens, but always found that, if I trusted to my fingers alone, three examples at least would make good their escape to every one that I succeeded in taking.

In the accompanying illustration will be seen a magnified representation of the *Phytocoris*, which will give a better idea of its appearance than many pages of description.

THE Bed-bug (*Acanthia lectularia*) is one of the many insects which, although not indigenous to this country, have, nevertheless, when once introduced, found in it a permanent home, and spread to all parts by gradual degrees, until scarcely any spot remains untenanted. We have a similar instance in the case of the cockroach, and, as the females of both insects are wingless, it is evident enough that they must have been both imported and distributed by human agency.

In the bed-bug both sexes are apterous, the wings being represented merely by four tiny scale-like objects on the thorax, so minute as to be invisible, excepting by close inspection. The body is almost circular and very flat, and the legs short, so that the insect can creep into narrow crevices, and thus escape observation. It is, doubtless, owing to this fact that its distribution is so general, for its small size secures it from notice, and allows it to be carried from place to place without the knowledge of its bearers.

Bed-bug (*Acanthia lectularia*), and side view of Head.

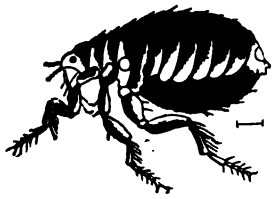
The bed-bug is a many-brooded being, four generations appearing in the course of the year from eggs laid in the crannies in which the insect loves to dwell. In order to fix them securely in their place,

these eggs are covered with a kind of varnish, which hardens rapidly when exposed to the air, and admirably fulfils the required purpose. The larvæ appear in about three weeks time, and assume their perfect condition about a couple of months later, their general appearance altering but little excepting in point of size. It is rather a remarkable fact that several insects belonging to the same genus as the bed-bug are parasitic on certain birds, in the nests of which they may frequently be found. The swallow, for instance, plays the part of involuntary host to one of these, which is rather apt to make its way into our houses. Like its more generally familiar relative, it is possessed of a peculiarly unpleasant odour, which it is able to expel or to retain at will.

Annoying as the bed-bug undoubtedly is, it must not bethought that human blood forms its natural food. Thousands of specimens live and die without crossing the track of man, and these are strictly vegetarians, subsisting entirely upon the juices which they extract from plants by means of their sharp beaks, just as is the case with most of the *Heteroptera* found in this country. When they can obtain blood they infinitely prefer it, as is evident from the fact of their remaining in houses from which they could escape without difficulty. But it is, nevertheless, a luxury, and a luxury alone to them, just as is human flesh to the man-eating tiger, and cannot be considered in any sense as a necessary of life.

Beak of Bed-bug.

The same may be said of the Flea (*Pulex irritans*), which, however, belongs to a different order from that of which the more repulsive bug is a member.



Flea
(*Pulex irritans*).

The order in question is that of the *Aphaniptera*, or "wingless" insects, a small and unimportant group consisting of but few members, none of which attain to any great size. The name of the order is by no means an appropriate one, for, as we have already seen, many insects which do not belong to the *Aphaniptera* at all are totally destitute of all but the merest rudiments of wings, and would therefore have equal claim to such a title. All that can be said for it is, that the peculiarity is common to all the members of the group, whereas in all other orders there are some few winged species.

In the case of the flea, however, the place of wings is in great measure supplied by the hinder legs, by means of which are taken the wonderful bounds which are so characteristic of the insect. A flea at a single leap will cover a distance equivalent to two hundred times its own length, rising at the same time to an altitude equal to thirty times its height—much the same as if a man of average stature were to spring 170 feet into the air, and to descend 380 yards from the spot whence he rose.

The frequency with which the power of leaping is

possessed by insects is worthy of notice. We find it, in the case of the beetles, common to all the members of the large group of *Halticidæ*, which includes the turnip-fleas already described, and also to many of the weevils, as well as to certain members of other families. In the *Orthoptera*, the grasshoppers and crickets are almost equally favoured, while the *Homoptera* and the *Heteroptera* both include many leaping species. In all these cases the power is due to the structure of the hinder limbs, which are of greater length than the anterior pairs, and are gifted with extreme muscular strength, resident principally in the thighs, which in most cases are considerably thickened. The leaping apparatus of the skipjacks and the sugar-lice (*Lepismæ*), however, is of a different character, that of the former consisting of the spine upon the lower surface of the thorax, which has already been described, while the latter are furnished with two bristle-like organs at the end of the body, which act in much the same manner as do the leaping limbs.

When placed beneath the microscope, the body of the flea is seen to be covered with rows of short, strong bristles, the points of which are directed backwards, while the hard and horny edges of the segments which compose the body overlap one another like the eaves of a house. To these facts is principally due the flea's wonderful power of forcing its body from between the fingers of its captor, its great muscular strength enabling it to work its way slowly forward, while the bristles and the projecting edges render backward motion impossible.

Unlike insects in general, the flea is by no means prolific, and seldom deposits more than twelve eggs in all. The larvæ which proceed from these are very curious little creatures, quite unlike their parents, and entirely destitute of limbs, the place of which is taken by rows of bristles placed at intervals upon the body. The pupa, however, which is quiescent, bears a distinct resemblance to the perfect form, the limbs being developed, although enclosed in membranous coverings, and the shape of the body having undergone considerable alteration from that of the grub.

The troublesome qualities of the flea are, of course, due to its beak, or proboscis, by means of which the blood of its victims is sucked into the mouth. As far as the general principle of its structure is concerned, this beak bears a very strong resemblance to the corresponding organ in the various plant-bugs, being nothing more than a modification of the identical mouth-parts found in those insects which are furnished with jaws. In certain minor details, however, it differs to some little extent, and also varies in certain of the individual species.

Pupa of Flea.

BOTH the flea and the bed-bug are noxious insects, of course, merely in a restricted sense, for, beyond the bodily annoyance which they cause, they inflict upon us no absolute injury. The habits of both clearly undergo considerable alteration when they are brought

into contact with man. The flea and the bed-bug known to civilised man are probably altogether different, as far as their life-histories are concerned, from the same insects in a state of nature. And, as habit undoubtedly influences structure, we may proceed yet further, and conjecture that the ancestral form of these insects differs in many important respects from that in which we now see them, and that, although both varieties, if we may so term them, may be not only co-existent to the present day, but also familiar to ourselves, they are so widely dissimilar from one another that their connexion is now no longer apparent.

Even very slight peculiarities of structure are sometimes held to afford specific value. An extra joint in the antennæ, the density and strength of the punctuation of the body, slight diversity of shape, have in many cases decided the claims of an insect to consideration as a separate species, even when every detail of the life-history has been of a similar character to that of otherwise identical forms, and both have been found dwelling in company together. And it is only natural to suppose that an insect, the whole tenor of whose life had undergone a total change, should come to differ, in course of time, in far more important particulars from those of its own species whose surrounding conditions had remained unaltered, than do many species from others whose habits are almost precisely similar, a widely different form being thus gradually evolved whose true origin it would be almost impossible to ascertain.

CHAPTER XIV.

DIPTERA, OR TWO-WINGED FLIES.

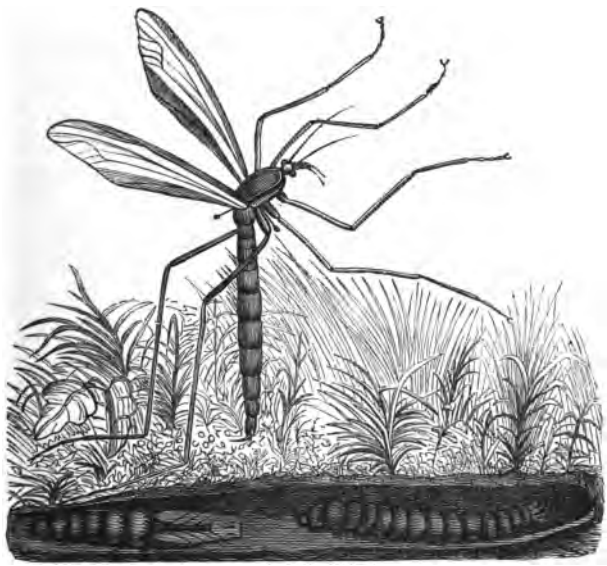
Characteristics of the *Diptera*—Absence of the hinder wings—The "halteres," or "balancers"—Their mysterious influence upon flight—The "alulets," and their true character—Structure of the mouth—The Daddy-long-legs—Use of the long hind limbs—Life-history—Voracity of the grubs—Damage caused by their incessant attacks — Beneficial influence of wet—Insectivorous birds and the daddy-long-legs grub—The *Muscidæ*—The mangold-fly and its ravages—Life-history—Appearance of the perfect insect—Relatives of the mangold-fly—Their injurious qualities—Bot-flies—*Gasterophilus equi*—Its curious life-history—The Gad-fly, or Wurble—Life-history—The Sheep-fly—Conclusion.

In the last of the twelve orders into which insects are divided, namely, the *Diptera*, or Two-winged Flies, we have many species which are more or less injurious to us, by no means the least important of these being the common Daddy-long-legs, or Crane-fly (*Tipula oleracea*).

This is far too familiar an insect to require special description, and yet there are one or two points in its structure which, although they are not at once apparent to the eye, nevertheless merit a few words of passing mention.

The first, and perhaps the most interesting, of these relates to the wings. Insects in general, of course, possess four of these organs, upon the forma-

tion of which is based the present classification of their owners. It is not necessary that both pairs should be used in flight, as we find in the case of the beetles, the earwigs, and others, whose upper wings merely serve the purpose of a protection or cover for



Metamorphoses of Daddy-long-legs.

the lower, which can be neatly folded and packed away beneath them while not in actual use. Nor is it indispensable that they should be available for their legitimate purpose at all, for, as we have previously seen, many species possess but the merest

rudiments of wings, apparently serving no purpose whatever, and utterly unsuited to the task of bearing their owner into the air.

But, in the case of the *Diptera*, we find a peculiarity characteristic of this particular order alone, which applies to the hind-wings only, and presents them to us in a form so different from that in which we are accustomed to see them, that it is at first sight difficult, and almost impossible, for us to recognise their true character.

Dealing in seeming paradoxes, we may say that the hinder wings of the *Diptera* are present, and yet wanting. We may say that those organs are useless for purposes of flight, and yet that flight cannot be carried on without them. And still, strange though it may appear, we shall be speaking the literal truth, exaggerating nothing, and employing no imaginative language in which to express the facts of the case.

If we take a drone-fly, or a gnat, and examine its structure with the utmost care, we can find but two wings alone. These are distinct enough, and it is perfectly clear that the hinder pair are not linked to them by a chain of minute hooks, as is the case during flight with those of the bees and wasps, rendering the line of junction so perfectly exact that it is difficult to ascertain the point at which it lies. And, for some little time, we may fail to recognise them even in an altered form.

But a close and careful inspection at last reveals to us the fact that, situated exactly in the position which those organs might be expected to occupy, are

two small and almost spherical objects set at the extremities of short footstalks. These are, in fact, the hinder wings in a modified form, and, owing to their resemblance to the weights of which the Greek athletes were in the habit of making use while leaping, are scientifically known as "halteres," and popularly as "balancers."

Small, and even minute, though these balancers may be, they nevertheless exercise a wonderful and mysterious influence over the power of flight. Their form and, in a still greater degree, their insignificant size, prevent them from being employed in any way as organs of locomotion. Nor, it would be thought, can the object of their presence be that implied by their name. And yet, if they be removed, the capability of flight is destroyed.

It would seem, therefore, to be evident enough that the balancers possess some important, although undiscovered, influence upon the power of aërial locomotion; and, were all the *Diptera* formed in a similar manner, we might rest contented with this explanation of their office. But such is not the case, for there are many members of the group which do not fly at all, but which, although the fore-wings are absent, yet possess the balancers in a perfectly identical form. It is, consequently, almost certainly the case that these organs, although their influence upon the power of flight is of principal importance, must also subserve some secondary purpose, with which, however, we have as yet altogether failed to make ourselves acquainted.

Even the upper wings themselves have generally a curious structure, which causes them to appear as though two smaller wings were present at their bases. These, however, which are technically known as "alulets," are not wings at all, but are merely appendages of the upper pair.

The mouth, too, of all dipterous insects is adapted to purposes of suction alone. No two-winged fly possesses jaws of any kind, those organs and their supplementary parts being modified into a beak, just as is the case with the bishop's mitres and the flea. In some cases this beak is armed with certain piercing instruments, of whose efficiency most of us have had satisfactory, or unsatisfactory, experience in the case of the common gnat.

THERE are several British species of Daddy-long-legs, but, as the habits of all are almost precisely similar, we will take that already mentioned as a type of the group.

As is necessarily the case, owing to the formation of the mouth, the destructive work of the daddy-long-legs is carried on while it is yet in the larval state, at which period of its development it lives beneath the surface of the ground and feeds upon the roots of various crops.

The eggs are laid in a rather curious manner, which at once points out the object of the singular length of limb from which the insect derives its popular title.

Standing almost erect upon her hinder legs, the

female insect places the point of her sharply-tipped ovipositor upon the ground, and then proceeds to twist her body from side to side, just as a carpenter turns the bradawl with which he is boring a hole in a plank. In a very short time the extremity of the body is buried in the soil, and a single egg deposited, after which the insect shifts her position and repeats the operation, and so on until her task is completed.

The grubs, when fully grown, are about an inch in length, and are clothed with so hard and tough a skin as to have earned for themselves the title of "leather-jackets." Like those of the flea, they are quite destitute of limbs, and are of a dirty-brown colour, very similar to that of the soil which they inhabit. The head is extremely hard, and is armed with a pair of strong, horny jaws, which cut their way through the roots of grass, &c., with the most perfect facility. From May until August or September these grubs continue steadily at work, feeding upon the roots of a variety of plants, and often causing terrible damage by their ceaseless depredations. Grass-land is especially liable to their attacks, and the abundance in which they sometimes appear may be realised from the fact, mentioned by Messrs. Kirby and Spence in their well-known "Introduction to Entomology," that no less than two hundred and ten specimens have been taken from a single square foot of turf. In this case, however, the larvæ were those of a different species.

It is a rather curious fact that wet, which is, as a general rule, most injurious to insect life, seems

absolutely beneficial to the propagation of the daddy-long-legs, which are mostly exceedingly plentiful after a warm and damp season. Of this fact we have quite lately had an admirable example in the extraordinary abundance of the insects in the autumn of 1883, after the exceptional wet of the preceding season.

Were it not for the unceasing labours of such birds as the starling and the rook, it is difficult to see in what manner we could successfully cope with these larvæ, whose subterranean habits render it almost impossible to attack them without causing the very damage which we are anxious to prevent. But these birds, the former more especially, detect at once, probably by their keen sense of hearing, the presence of the buried grub, which is speedily unearthed by a blow or two from their strong bills, and carried off in triumph. The starlings may often be seen engaged upon this operation in meadows and upon lawns, particularly in the earlier part of the day, almost every dig of their beaks signifying that another of the destroyers has been removed from the scene of his labours, and prevented for ever from carrying on his mischievous work.

The rook, too, although he may, perhaps, prefer larger game, is yet extremely serviceable in the slaughter of these grubs, as has been most satisfactorily proved by a correspondent of *Science-Gossip*, who writes as follows :—

"About ten days ago a rook from amongst a flock which were feeding in a meadow here was shot for

the purpose of ascertaining what they were so busily looking after. In its mouth, or pelican-like pouch, in which they carry food to the sitting hens and to their young ones, were found twenty-one *Tipula* grubs, which, no doubt, were intended for young which had escaped rook-shooting. I find rooks in an hour, on an average, visit their young in nests about four times; and if we take that as a fair specimen, eighty-four of these grubs are destroyed per hour for each nest."

Several other birds are almost equally useful, the pheasant, the lapwing, and various gulls being worthy of special mention. No less than 1,225 of the grubs have been on one occasion taken from the crop of the former of these birds, affording conclusive proof of the service which it renders to us in the way of insect-destruction.

As soon as their growth is completed, which is generally the case early in August, the grubs assume the pupal form, from which the perfect insects emerge in the course of two or three weeks. Just before their appearance, the pupæ work their way upwards, by means of certain transverse rows of bristle-like spines which are placed at intervals upon the body, until they project above the surface of the earth, in order that the flies may have no difficulty in making their exit. According to a careful observer, the females sometimes have great difficulty in withdrawing their bodies from the pupal shell, and are in such cases assisted in the task by the males. The empty pupa-cases may often be seen in numbers after the

flies have emerged, the upper half of each projecting above the surface of the ground, and forming a fairly conspicuous object.

Some thirty species of *Tipula* are known to inhabit this country, most, if not all, of which are injurious to vegetation in the same manner as that already described. Many of these, however, are so similar in general appearance that none but a practised entomologist would be able to detect the differences between them, and as the habits of all those with whose life-histories we are acquainted are of an almost identical character, it is unnecessary for us to devote to them any individual attention.

In the great group of the *Muscidæ*, which includes many hundreds of British species, and to which the well-known Horse-fly and Blow-fly belong, we find several injurious insects, among which some of those belonging to the genus *Anthomyia* call for special mention.

The most important of these, perhaps, is the Mangold-fly (*A. betæ*), whose ravages have of late years brought it into particular notice. It is a curious fact that the destructive properties of this fly would seem to be of comparatively recent origin, for, until 1880, the insect was scarcely considered as an injurious species at all, and had never been recorded as causing any special damage to the crops. Suddenly, however, the fly appeared in myriads and rapidly spread over the country, devastating the turnip crops, and causing an almost

incalculable amount of mischief. In 1882 it was again exceedingly plentiful, and was almost equally injurious, the eggs being laid while the plants were yet young and delicate, and the grubs devouring the leaves to so great an extent as generally to inflict a fatal injury.

The life-history is briefly as follows :—

The eggs, which are very small white objects, are affixed by the parent insect to the lower surface of the leaves, where they may be found in small clusters by a careful investigator. In the course of a few days these produce small yellowish-white larvæ, which at once bore into the leaves and take up their abode between the upper and lower surfaces, feeding upon the soft pulpy substance therein, just as do the grubs of the turnip-flea. In the course of three or four weeks their growth is completed, and they assume the pupal form, either in their burrows, or, more commonly, just beneath the surface of the soil, in which they bury themselves for that purpose. When full-fed these maggots are about one-third of an inch in length, cylindrical in form, and entirely without limbs, which in their peculiar mode of life could be of no possible service to them. The pupæ are chestnut-brown objects, rounded at either extremity, and look very much like exceedingly minute German sausages.

Excepting that the extremity of the body is more pointed, the perfect insect is not unlike the common house-fly, for which, indeed, it might readily be mistaken by a casual observer. In ordinary seasons

it appears on the wing during the month of March, a second brood appearing later on in the year.

Another species of *Anthomyia* devotes its attention to cabbages, the roots and stems of which are perforated by its larvæ, and the health of the plants considerably injured. A third, known as *A. lactucæ*, feeds on the flowers and seeds of the lettuce, while a fourth, *A. ceparum*, inhabits the bulbs of the onion, and often completely destroys them.

Not only are the grubs of these flies injurious to the plants themselves, but they seem also to be extremely hurtful to the human constitution, if accidentally taken into the stomach with the vegetables which they frequent. Mr. Curtis has touched upon this subject, concerning which he makes the following remarks:—

"From the large quantities of these maggots which have been ejected from the human stomach, accompanied by the most distressing symptoms, I am led to conclude from their economy that the eggs or larvæ are conveyed into the stomach in badly or half-cooked vegetables, for it is evident they subsist upon decomposing vegetables and excrementitious substances, and I have found similar but very small larvæ on cabbage-leaves in October. It is therefore very probable that, under certain morbid conditions of the constitution, they are able to live in the human body until they have arrived at their full growth, when they are necessarily ejected, to become pupæ, and after a short time to be transformed into flies."

WE now come to a class of *Diptera* whose habits are entirely different from those of any insect with which we have as yet had to deal, namely, the well-known *Œstridæ*, or Bot-flies, which are parasitic upon cattle.

Scarcely any of the larger mammals are altogether free from the attacks of these insects, which set at defiance even the tough and stout hide of the elephant or the rhinoceros, and by their incessant attacks cause considerable suffering. So great is the influence which they exert upon the bodily powers of their victims, indeed, that both Bruce and Dr. Falconer, the travellers, conclude that it is owing to the efforts of parasitic flies alone that these animals have not so greatly increased as entirely to over-run the countries which they inhabit.

Ovipositor of Bot-fly (Magnified).

Our first example of these insects is the common Bot-fly (*Gasterophilus equi*), whose life-history is of a most singular character.

During the earlier stage of its development this fly is parasitic upon the horse, the eggs being laid by the parent upon the hairs in such parts of the body as are well within reach of the animal's tongue. In the course of a few days the eggs are licked off and transferred to the stomach, wherein they shortly hatch, producing tiny larvæ, which at once attach

themselves to the membrane with which the interior of that organ is lined. In some cases the number of these grubs is enormous, the little creatures retaining their position by means of a series of tiny hooks with which the head is armed, and appearing to subsist upon the various secretions.

Throughout the autumn and winter months these

Larvæ of Bot-fly in Stomach of Horse.

grubs continue their parasitic work, and increase slowly in size until the return of spring, when they loosen their hold and pass from the body. As soon as they reach the ground they bury themselves therein, and assume the pupal form, from which the perfect insects emerge in the course of three or four weeks.

The exact amount of the mischief caused by these grubs appears even yet to be uncertain. Several

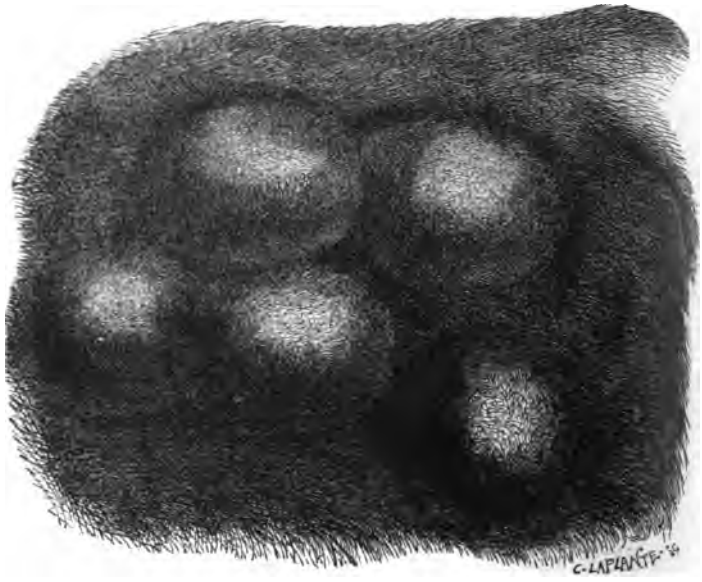
authorities have denied that they are in any way injurious, while others are equally positive that the health of the animals attacked is greatly affected by their presence. This latter supposition would certainly appear to be the more correct, for it is incredible that a large number of these grubs should maintain for several months a constant drain upon the juices of the stomach, and yet cause no injury to their involuntary host.

The bot-fly is a very pretty insect, the thorax being black, relieved by patches of reddish hairs, the abdomen black, banded with chestnut-brown, and the wings slightly clouded with the same colour.

Eggs of Gad-fly on Hairs of Horse.

THE Gad-fly, or Wurble (*Œstrus bovis*), although equally parasitic with the previous insect, takes up its abode in a different part of the system, the eggs being laid upon various parts of the body which the tongue cannot reach, and the grubs penetrating into the skin, in which they dwell throughout their larval existence. The presence of these grubs may be at once detected by the small swellings, looking not unlike the galls upon a plant, to which they give rise, and through an opening in the upper part of

which the tails of the insects may be seen. When fully grown, the grubs work their way out of the skin and allow themselves to fall to the ground, in which



Swellings produced in Skin of Cattle by Larvæ of Gad-fly (*Œstrus bovis*). Magnified.

they burrow and pass through their remaining transformations.

According to Professor Riley, the well-known American entomologist, the Illinois farmers are in the habit of rubbing the backs of their cattle with either kerosene oil or mercurial ointment during the autumn,

a means of prevention which in most cases proves effectual.

A third species, the Sheep-fly (*Œstrus ovis*), is equally troublesome to sheep, depositing its eggs within their nostrils, in spite of all their efforts to prevent it from doing so. The grubs, when hatched,

Sheep-fly (*Œstrus ovis*).
Magnified.

creep along the interior of the nostril, by means of the small hooks with which their heads are furnished, and attach themselves to the frontal sinus, where they remain until their growth is complete. The remainder of their life-history is similar to that of the preceding species.

CONCLUSION.

We have now arrived at the conclusion of our task, and have noticed, although but superficially, the habits of the more prominent of those insects which have been proved injurious to our interests. A large number have of necessity been omitted, either from the limited character of their ravages, or from their similarity to other species, which rendered separate description superfluous; while we cannot but suppose that advancing knowledge, in acquainting us with the life-history of many beings whose economy is as yet unknown, will largely add to the already lengthened catalogue of injurious insects. Many which now occupy a neutral position with regard to ourselves will almost certainly, by our own act, become noxious; let us hope that in many instances the reverse may be the case; for we cannot feel sure that there is one single created being which may not, in some way or other, become serviceable to ourselves. Any of those insects, for example, which annually bring about such mischief to our crops may furnish us with some product of inestimable value in our arts or our manufactures, just as is the case with the lac-insect and the silk-worm; while many of the most injurious may even now be working us some hidden good, whose benefits we enjoy, although totally ignorant of the source from which they arise.

Meanwhile, in dealing with those insects which are, as yet, our foes, we may safely consider that our best and wisest policy is to trust more to Nature's efforts than to our own. Far better is it for us to encourage the agents to which she has deputed the task of regulating the abundance of the noxious species, than to waste both our time and our money in experimenting with various chemicals and washes, which in almost every case are absolutely ineffectual for the purpose for which they are intended. No injurious insect is without its natural enemies, which are perfectly ready and willing to perform their allotted duties, if we will only allow them to do so. Our best endeavours should be given to encourage these, and, by judicious manuring, to accelerate the growth of our crops, in order that they may speedily attain to maturity both in size and strength, and so be enabled to withstand attacks which, were they in a less developed condition, would inevitably be fatal.

And, in particular, let us allow the various insectivorous birds full and undisturbed access to our gardens and fields. Even the much-persecuted sparrow, which undoubtedly causes considerable mischief at times to certain crops, is, nevertheless, far more our friend than our foe, as may be seen from the fact that a single pair of the birds, when carefully observed, have been seen to convey to their nest an average of forty grubs *per hour* throughout the day. Carry the calculation on, and see what this amounts to. Assuming, as we may fairly do, that the birds would work for twelve hours out of the twenty-four, we have a result of 3,360 grubs destroyed by the one pair in

the course of a single week. Supposing, again, that ten weeks are occupied in bringing up the two broods of young, no less than 33,600 grubs would be required for food, irrespective of the vast number which would be destroyed by the birds at other seasons of the year. Multiply this 33,600 by one-half of the adult sparrows in the kingdom, and the product would be almost too vast for figures to express.

The damage which the birds themselves cause is not one tithe as great as that which would be wrought by the insects which they destroy, of which fact we have had abundant proof in more cases than one. In Maine, for instance, a Government edict went forth that sparrows were to be ruthlessly exterminated. By dint of great labour, and at great monetary cost, this resolution was carried into effect, and the farmers were rewarded in the ensuing season by the total ruin of their crops from the unchecked ravages of injurious insects. More than this, the very trees themselves were stripped of their leaves, the caterpillars which devoured them finding themselves masters of the situation, and effectively showing the insane folly of the suicidal act which had sought to preserve the crops by the slaughter of the very beings which alone could save them from destruction.

At Auxerre, some time since, similar steps were taken with a precisely similar result; while in every case of even partial diminution in the number of birds the decrease has been attended by a proportionate falling-off in the quantity and quality of the crops.

I may possibly be met with the objection in that

New Zealand, into which country some little time ago the sparrow was imported, the bird has increased in numbers with wonderful rapidity, and by its constant depredations has proved a terrible hindrance to agriculture. This is true enough, but then, it must be remembered, New Zealand is not the natural home of the sparrow. We have, in fact, in this case one of the many instances in which man has taken upon himself to interfere with Nature, only to find in how great a degree she resents his presumption. A bird is taken from its home and placed in a land in which, although the climate is suitable, the conditions of life are totally different. Its former habits can now be habits no longer, for its near surroundings are utterly unlike those to which it is accustomed. Is it to be wondered at, then, that fruit and grain should suffer as soon as the numbers of the feathered colonists increase beyond a certain point? The cases of New Zealand and our own country, indeed, are on a perfectly different footing, and cannot possibly be considered as affording grounds for comparison.

I have personally met with an instance of the value of the sparrow in Great Britain, in the case of a large kitchen-garden in Kent. This garden, in which the small birds are encouraged and in which sparrows abound, is surrounded on three sides with an orchard belonging to another proprietor, who employs men to continually patrol the ground, and shoot down without mercy every bird seen on his premises. From sunrise to sunset the reports of the guns are heard; sparrows, finches, and titmice are slaughtered by hundreds. In the garden, on the contrary, the little

birds congregate in flocks, and may at any time be seen busily engaged in the vegetable-beds or upon the fruit-trees, becoming so tame that they might almost be captured by hand.

The results of the two modes of treatment are evident enough. The orchard yields barely sufficient produce to repay the owner for the money and labour expended upon it, for the various fruit-destroying insects are left wholly to themselves, and pursue their mischievous course unchecked by the foes which, if allowed to do so, would have killed them off by tens of thousands. In the garden, however, the fruit-crop is so large that year after year it can scarcely be gathered in, the currant-bushes, more especially, being so heavily laden that a considerable proportion of their produce is necessarily left unplucked.

What more convincing proof could we have of the value of the birds? And can we, in common fairness, grudge them the comparatively small quantities of grain, &c., which they devour when stress of weather prevents them from procuring their natural food? And yet, at the moment at which I write, the farmers of one of the northern counties of England, in their exalted wisdom, are, according to one of the daily newspapers, in the act of making arrangements for the wholesale destruction of sparrows throughout the county, and are binding themselves to carry out the proposed operations, each in his own neighbourhood, as completely and thoroughly as possible.

Can it be believed that such crass ignorance should prevail at the present day? that agriculturists should be so blind to their own interests as to ruthlessly

destroy their best friends, and so to condemn themselves to even greater losses than those which they are trying to avert? Yet such is unhappily the case, and thousands upon thousands of useful creatures will, before these lines appear in print, have paid with their lives the penalty of human—and inhuman—ignorance.

In the slaughter of these birds, the farmers in question, while meaning well, will have done more harm than they can ever undo. They may come to recognise their error, but they cannot restore life to the beings which they have slain. And, moreover, the inevitable increase in the numbers of the injurious insects consequent upon the destruction of the birds must go down as a legacy to their descendants, even as we ourselves are now feeling the consequence of the folly of preceding generations.

It is humiliating to reflect that, in talking of the ignorance of our predecessors, we are not one whit wiser than they? We know, and acknowledge, that by the perpetual slaughter of the smaller birds they administered a check to agriculture from which it has not even yet recovered; but do we profit by their example? We know that the mole performs a threefold service to us by destroying the subterranean grubs, by establishing a wonderful and elaborate system of subsoil drainage, and by bringing fresh and fertile soil to the surface, and so directly assisting the growth of vegetation; but do we encourage him in our pastures? We know that the titmice are almost wholly insectivorous; but do we allow them to carry on their beneficial work in our orchards? It would

really seem, indeed, as though we considered our knowledge as an abstract quantity, not to be put into practice, and having no personal application to either ourselves or our interests, for, notwithstanding all that we have learned, we still travel on in the same old track, making the same mistakes as our forefathers, but erring, not from ignorance, as they did, but from totally inexcusable stupidity.

Is it too much to hope that, in the future, we may learn to trust more to Nature and less to ourselves? that common sense may take the place of worn-out fallacies? Is it impossible that we should ever recognise the fact that Nature is capable of preserving her own balance, if we can only refrain from thrusting upon her our ill-advised interference? Let us henceforth trust principally to her provisions, supplementing her efforts, if need be, by our own, but relying chiefly upon her appointed agents, and not upon our own unaided endeavours. Two armies, when uniting against a common foe, are far more powerful than when acting irrespectively of one another, and so we shall certainly find in the present instance. Let us combine with Nature. Union, as the old adage reminds us, is strength, in this as in all else. No better watchword can we have for the conflict that lies before us, and no alliance which affords us so great hope of success in the incessant strife between ourselves and our Insect Enemies.

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